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The Countryside Network

The rural field, as an inviting prospect for central-station service, becomes a reality under the light of such figures as those marshaled by Mr. Samuel Insull, who now demonstrates for the case of scattered country communities, as he has already done for urban centers, that a unified system of generation and distribution will not only save important plant investment and operating costs but accomplish developments in the extent, variety and usefulness of electric service far beyond anything that would ever be possible with mere individual local stations. In addition to the routine lighting and motor service of the towns themselves as cited by Mr. Insull in his Franklin Institute address, outlined in this issue, the supply of energy for interurban electric railways, water pumping, ice making, farm operations, drainage, mining—and even a hint at railroad electrification in the future—offer important loads for the rural network. And as regards the magnitude of these openings, we need only mention the speaker's own estimate that for the State of Illinois alone the combined service opportunities of this kind exceed by 20 per cent the present output of the great Chicago system itself. But most significant of all is the diversity with which these various rural demands occur, as regards both their daily and annual load curves. Even when not representing distinctly off-peak demands by their very nature, many of these applications are so flexible that they can be controlled with ease to avoid the system peaks. And, although some of the uses cited have not in themselves particularly high load-factors, their combined showing indicates possibilities of a system load-factor of nearly 50 per cent, with a diversity of 35 per cent in the use of the power supply equipment—figures which will certainly arouse the interest, if not the envy, of many central-station operators furnishing electricity in densely populated and progressive urban centers.

Pennsylvania Electrification

In a recent note on the establishment of a correspondence school of electricity for Pennsylvania Railroad employees stress was laid upon the significance of this step in connection with the company's electrification plans. Confirmation of this view has come sooner than expected in the announcement just made that the Pennsylvania will within the next year spend $4,000,000 on the electrification of the "main line" out of Philadelphia as far as Paoli, a distance of about 20 miles. The figure stated is understood to cover only the track work and not to include the power house which will be erected or the locomotives. While the announcement refers to this work as being "for suburban passenger traffic," it requires no stretch of the imagination to see in it the beginning of an electrified system. Even as a localized undertaking, no little satisfaction is to be derived from this latest extension of the territory that electricity is steadily conquering in the world of transportation.

A Vital Trade Problem

Of all the subjects discussed at the recent meetings of the Society for Electrical Development no one topic occupied so much time or drew so much fire as did the need for readjusting the merchandising relations and activities of central station, jobber, dealer and contractor. As very forcibly put by one of the jobbers who took a leading part in the discussion, what the dealer, contractor and jobber demand are "decent merchandising conditions." Other speakers reiterated the demand that central stations shall not, as a means of promoting their principal business, namely, the sale of energy, cut under the prices that contractor, dealer and jobber must charge in order to live. This is an old problem, but one of which the last will not be heard until it is met and solved, not because the commercial salvation of certain men demands a solution, but because upon this solution depends the working out of the whole problem of distribution of electrical supplies and apparatus. So far the attempts in this direction have resulted in little more than the development of an irreconcilable conflict. The central stations, on the one hand, say that they are willing that others should do the work if they will really do it effectively; while the dealers, jobbers and contractors, on the other hand, assert that they can and will do the work to be done if a chance is given to them. If the Society for Electrical Development can work out the solution of this problem on a basis of real co-operation, of give and take by all concerned, it will by this one accomplishment contribute enormously to commercial electrical advancement.

Hydraulic Storage and Auxiliaries

The Mount Hood plant, described elsewhere in our columns, is interesting chiefly on account of the somewhat unusual hydraulic situation there developed, in that it is constructed for the utlization of three distinct sources of supply of water at three different heads, high, medium and low, the two former being planned for utilization in the same power house. The present plant involves the intermediate head only, the water being collected in a reservoir site some 325 ft. above the river which serves as the discharge. At double this height and very near lies a high reservoir site which can be reached from an independent drainage area by building some 10 miles of aqueduct. The present intermediate head reservoir is reached by a little

more than 3 miles of aqueduct, which is a wooden flume of the type widely used on the Pacific Coast. The reservoir for this head covers about 160 acres and is in the main inclosed by an earthen embankment. The reservoir is large enough to permit the generator to carry full load of some 11,000 kw for thirty-six hours, so that the question of daily peak is eliminated and the real hydraulic problem involves a study of the all-the-year-round supply. The whole watershed touched by the project is of substantially the same character, so that no relief is to be obtained by, so to speak, a diversity-factor in the supply. The rainfall in this region is very large, being probably not less than 7 ft.

In spite of the amount of rainfall and the considerable storage area, the dry season is itself very seriously felt. There exists the somewhat unusual condition of a plant which, in spite of large storage and exceptionally great rainfall, must still be reinforced during a part of August and September by an auxiliary steam plant. This fact shows exceptionally well the conditions which confront the engineer in attempting to secure the maximum use even of a very promising hydraulic privilege. More and more as the water-powers of the country are utilized does the problem of the low-water season confront one. Even a high-head development with good storage facilities can rarely carry its load through the month of minimum rainfall. Remedies for this situation can lie only in extraordinary storage capacity under an exceptionally high head or in the deliberate provision for auxiliary power. In taking the latter horn of the dilemma one faces a yet unsolved problem as to the selection of the most economical form of auxiliary equipment for obtaining a relatively large output during a very brief period.

The Sounder in Submarine Cable Telegraph

References have recently appeared in the technical press concerning a new method of transatlantic cable telegraphy devised by Mr. John Gott, employing the Morse key and Morse receiving instrument, instead of a pair of keys and siphon recorder at the respective ends of the cable. Details of the apparatus employed have not yet been made public, but an outline description of the method employed, written by Mr. Edward Raymond-Barker, appears in a recent number of the London *Electrical Review*, as referred to in this week's *Digest*. The transmitted signals are ordinary Morse signals, except that they are always successively alternating in direction. That is, they consist of short and long impulses, or dots and dashes, but no two successive impulses have the same polarity, although produced through successive contacts of the same Morse key. Automatic means are provided for reversing the current direction at each contact. The signals thus resemble alternating currents, it being understood that standard alternating currents employ rhythmically reversing impulses of uniform duration and spacing, whereas the impulses used by the new method, in spelling out letters, employ reversing impulses that are not strictly rhythmic and by no means always of equal duration and spacing.

The continued succession of reversed Morse impulses is much more favorable to the operation of a Morse relay at the receiving end of a long cable than ordinary single-current working or unidirectional Morse signaling would be. On the other hand, double-current working is always the rule in long Morse circuits. In double-current working the marking impulse consists of a short current impulse, say positive, while the cessation impulse consists of a short negative current impulse at the proper moment. In this way dots and dashes are formed by successive impulses that are always in opposite directions—again an approach toward alternating-current transmission. It is thus difficult to see any salient superiority in the new method over double-current working, notwithstanding the manifest superiority over single-current working. A full description of the new system, when it is finally published, may clear up this obscurity.

New York State Hydroelectric Schemes

Agitation in favor of hydroelectric projects under state ownership and management in New York, inaugurated by the introduction of bills during the last session of the Legislature, continues with increased activity during the present session. Elsewhere we give an analysis of the important Murtaugh bill. In its general scope it is not unlike the Bayne bill considered by the last Legislature, but instead of launching forth at one leap into a state-wide hydroelectric system, the present measure, although it contemplates such a system ultimately, provides specifically for the creation of a single hydroelectric district for the city of Albany and neighboring municipalities, including Troy and Schenectady, with two developments at dams on the new barge canal. As a whole the scheme is inspired, as is well known, by the hydroelectric system of Ontario, concerning the financial success of which many conflicting rumors and stories have been in circulation. Certain causes for these rumors can be learned from the review in this issue of a book entitled "An Expensive Experiment."

The New York project must be considered at present very largely from the standpoint of its general advantages and disadvantages. Viewed first as a municipal ownership project, which must be under the control of one state administration after another, the outlook is anything but assuring. Listening for the moment to the pleadings of idealists, it must be conceded that it would not be impossible for a state executive of great ability, purity of motives and independence of action to stand behind one of these projects and see it through to completion and successful operation as efficiently as any group of private citizens or a public-utility corporation. This, we repeat, would be possible, but it is extremely improbable under the political traditions of the present day. Municipal ownership of public utilities is notoriously weak on the side of administration or management. Prevalence of the spoils system, rotation of officials in office, the temptation to yield to political expediency, and incompetence, all combine to defeat the promises of idealists who maintain that the lowest rates and the best service are obtainable only by municipal ownership.

A specific objection to the Murtaugh bill which covers a point of the greatest importance is the needlessness of creating a new regulating body to administer the project, independent of the Public Service Commissions. Municipalities

are empowered by the measure to engage in the distribution and sale of electrical energy purchased from the State, either by contracting with the local electric utility to act as a distributing agent, or by purchasing the local system, or again by constructing an independent municipal system. The vital point, the source of danger, resides in the fact that state energy will be sold under the sole jurisdiction of the State Conservation Commission. Clearly, then, a local utility which is under the jurisdiction of the Public Service Commission may find itself in competition with a municipal system under jurisdiction, both as to rates and service, of the Conservation Commission. This position is obviously anomalous and should be rectified by placing the whole scheme in the hands of the existing adequate machinery of administration—the Public Service Commission. Otherwise there is no protection whatever to the investors in existing utilities against public caprice, needless competition and the duplication of investment.

A splendid method for solving the fundamental problem of conserving the public water-power and devoting it to public use is found in the water-power law of Wisconsin, under which the Railroad Commission is clothed with jurisdiction and authority over the whole question. New York can hardly do better than follow this example, in the interest both of efficiency and justice to existing enterprises under private ownership.

Heterochromatic Photometry

An article in this issue by Mr. M. Luckiesh on photometry by flicker and by equality-of-brightness instruments raises some very curious questions as to the nature of the phenomena. Our readers will remember that in some recent researches by Dr. Ives it appeared that while at considerable intensities fairly concordant readings could be obtained by the flicker and by the equality-of-brightness photometers, yet at low values of the luminosity discrepancies appeared, sometimes showing the Purkinje effect, and in the case of the flicker instrument sometimes a small reversed Purkinje effect. Mr. Luckiesh's results on comparing red and green lights with these instruments were of a somewhat startling character, much less reassuring to the photometrist than those obtained by Dr. Ives. With an intensity on the screen of below 2 meter-candles, wide variations were found, a very pronounced Purkinje effect with the equality-of-brightness photometer and an equally pronounced reversed Purkinje effect with the flicker instrument. The former is, of course, naturally to be expected. Unless the reduction of the illumination from screen to eye was very much less than is ordinarily to be found, the magnitude of the discrepancies noted by Mr. Luckiesh is altogether remarkable, and particularly the reversed Purkinje phenomenon found in the flicker photometer.

Numerous observers have apparently found the Purkinje phenomenon itself under circumstances similar to those noted by Mr. Luckiesh, and the reason for this was pointed out by Dr. Louis Bell in our columns on Jan. 27, 1912, as due to the shifting of luminosity in the juxtaposed fields by reason of simultaneous contrast, producing a tendency toward a spurious Purkinje phenomenon at intensities materially higher than those at which the real phenomenon should naturally make its appearance. It was also pointed out in this paper that the same effect of simultaneous contrast would produce very varying results according to the particular colors involved and their places upon the luminosity curve. When it comes, however, to a marked reversed Purkinje effect with a flicker photometer the case is different. Here there is no simultaneous contrast to shift the apparent luminosities of the colors involved. The particular advantage, in fact, of the flicker photometer is that it abolishes the difficulties which come from simultaneous contrast. But a reversed Purkinje phenomenon is just as bad from the standpoint of precision as the direct effect, and it is therefore worth while inquiring somewhat into the situation as disclosed by Mr. Luckiesh's experiments. The first thing to note is that, whatever the cause of the phenomenon observed with the flicker instrument, it began to be felt at about the same degree of low intensity as the opposite variations in the equality-of-brightness photometer—that is, near the point at which color vision begins to fail. One is induced to ask why under such circumstances the red light should appear too bright instead of too dim as required by the Purkinje effect.

It would have been interesting had Mr. Luckiesh investigated this curious phenomenon at a variety of flicker speeds. It is quite possible that the time relations of the color stimuli might introduce variations in apparent intensity of considerable magnitude. If such were the case, one would expect that color differences would make themselves felt in studies of Talbot's law. The sector disk, however, was pretty thoroughly investigated at the Bureau of Standards a few years ago by Dr. Hyde, who did not find any error due to color difference, although Ferry, working under other conditions, had found such a difference. In view of these latest results it may be that the discrepancy noted could fairly be chargeable to differences in intensity and in speed of rotation of the disk, which latter factor, of course, influences the effect to be produced by the variation in the physiological factor under sudden stimuli. However this may be, it seems clear from Mr. Luckiesh's experiments that at low intensities, and at speeds where flicker is pronounced at these intensities, the color of the lights compared may be the important factor in the results.

The form of the flicker curves indicates that at the lower intensities the question of color adaptation may play an important part. When widely different photometric results are obtained with colored lights for a very small variation in intensity, as they are in this case, one naturally looks for adaptation as the disturbing factor. At all events, it is quite clear that even in using flicker photometers one must anticipate trouble at low intensities. Most observers find the flicker instruments difficult to use with low intensities, and it is perhaps safe to say that errors are not likely to be noticeable at intensities where one could comfortably work by flicker. Nevertheless the situation calls for further investigation. It is somewhat disconcerting to find such difficulties as these just after the investigations of Dr. Ives seemed to have put the flicker method on a sound basis. The difficulties should be cleared up at the earliest possible moment.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

New York Subway Contracts Signed

After three years of complex negotiations and heated controversy, the contracts for the operation of the dual rapid-transit system for New York City were signed on March 19.

These contracts relate to the operation of a system the total cost of which will be about $400,000,000. Of this, one-fourth covers the existing systems and $300,000,000 the construction now under way or authorized for the new subway, elevated and surface lines described in the *Electrical World* June 1, 1912. When the new system is placed in operation, which will probably be in 1917, there will be over 600 miles of single track in service, as compared with 271 at present. Chairman McCall, of the Public Service Commission for the First New York District, signed the contracts for the city, and his signature was attested by Mr. William R. Willcox, his predecessor, whose term expired before an agreement was reached on the subway question. Mr. Theodore P. Shonts, president of the Interborough Rapid Transit Company, signed the contracts for that company, and Mr. Timothy S. Williams, president of the New York Municipal Railway Corporation (Brooklyn Rapid Transit Company) signed them on behalf of these interests.

Work of New England Electric Development Association

The Electric Development Association, Inc., of New England distributed 38,200 copies of the February number of the organization's popular periodical, *The Silk Cord*, among individual users of electricity from lists furnished by central stations and contractors. In addition, 326 copies were mailed to the newspapers and 1000 copies placed on sale on news stands in the New England territory. Of the March number, just issued, 35,400 copies are being mailed to present and prospective electricity users. During recent months the association has encouraged the pushing of electric sales and emphasized the need of co-operation in many New England towns and cities. The secretary of the association is Mr. Zenas W. Carter, 53 State Street, Boston, Mass.

Nomination of A. I. E. E. Officers

At the meeting of the American Institute of Electrical Engineers, New York, March 14, President Ralph D. Mershon announced the nominations made by the board of directors for Institute officers for the coming year. These names are as follows: President, Mr. C. O. Mailloux, New York; vice-presidents, Messrs. H. H. Barnes, Jr., New York; J. A. Lighthipe, Los Angeles, Cal.; C. E. Scribner, New York, and W. S. Rugg, New York; treasurer, Mr. George A. Hamilton, Elizabeth, N. J.; board of directors, Messrs. F. A. Behrend, Boston, Mass.; P. Junkersfeld, Chicago, Ill.; H. A. Lardner, San Francisco, Cal.; Louis T. Robinson, Schenectady, N. Y., and Charles Robbins, Pittsburgh, Pa.

Mr. C. O. Mailloux, nominated by the board for president, is a charter member of the Institute, having signed the call for its organization in 1883. He has served three times on its board of managers and twice as vice-president. He represented the Institute at Paris in 1900, at London in 1906, at Marseilles in 1908, at Turin in 1911, and only recently returned from the conference of the International Electrotechnical Commission at Zurich, which he attended as president of the United States committee. Mr. Mailloux is also vice-president on international arrangements for the International Electrical Congress to be held at San Francisco in 1915. When the *Electrical World* was founded in 1883 Mr. Mailloux was a leading spirit in its organization, afterward serving as this journal's first editor.

Missouri Utility Law Enacted

A law creating a state-wide public utility commission for Missouri has passed the General Assembly of that State and on March 18 received Governor Major's signature. The new Missouri measure is in general modeled along the lines of the New York State Commissions law. It provides for the repeal of the Cooper enabling act, passed May 8, 1907, under which the present local commissions were established.

Annual Meeting of Electrochemical Society

The twenty-third general meeting of the Electrochemical Society will be held at Atlantic City April 3 to 5. At the opening session on Thursday morning Mr. I. Langmuir will deliver an address on conduction and radiation of heat, Messrs. F. A. J. Fitzgerald and A. T. Hinckley will read a paper on experiments with furnace electrodes, and Prof. J. W. Richards one on aluminum nitride. In the afternoon the following papers will be read: "Some Tests of the Edison Storage Battery," by Messrs. C. W. Bennett and H. N. Gilbert; "Concentration Cells Containing Organic Liquids Immiscible with Water," by Mr. R. Beutner; "Concentration Changes in Copper Sulphate Electrolysis," by Messrs. C. W. Bennett and C. O. Brown; "The Three-Phase-Two-Phase Induction Furnace," by Mr. A. E. Greene, and "Making Electric Steel Without Slag," also by Mr. Greene. At 8 p.m. on Friday a lecture on hyper-basis will be given by Prof. Frank B. Kenrick, of Toronto. On Saturday President W. Lash Miller will deliver an address introductory to a symposium on the electrodeposition of metals, during which the following metals will be discussed: gold and silver, by Mr. Francis C. Frary; copper, by Mr. C. W. Bennett, and brass and bronze, also by Mr. Bennett; cobalt and nickel, by Mr. O. P. Watts; lead, by Messrs. F. C. Mathers and B. W. Cockrum. Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa., is secretary of the association.

Analysis of the Murtaugh Hydroelectric Bill Before the New York State Legislature

The public-utility companies in New York State engaged in the production, distribution or sale of electrical energy in any way are all vitally concerned with the so-called Murtaugh bill now in the Legislature providing for the establishment of state hydroelectric systems, first in limited zones or districts and later in a state-wide system or distribution network. The scheme has its conception in the Ontario hydroelectric system, as made apparent in our

abstract of the bill in the issue of March 15. Great importance attaches to the fact that should this bill become law existing central stations may expect to find themselves sooner or later subject to enforced competition, beyond the jurisdiction of the public service commission and under the regulatory powers of an independent body, the State Conservation Commission. The evils which might grow out of this situation and their bearing on the prosperity of the central-station industry throughout the State need to be brought out into the light and thoroughly analyzed.

The Murtaugh bill contemplates a group of hydroelectric plants and a distribution network of tie lines, transmission lines and the necessary switching or transforming stations, under state ownership and management, for the purpose of wholesaling energy to municipalities and also, under restrictions, disposing of it to individual consumers, at wholesale or retail. The Conservation Commission is made the administrative body which will have charge of the whole scheme and will also fix in each instance the rates at which energy will be sold to the ultimate consumers, regardless of whether a municipality, a distributing company or the commission itself acts as the distributing agent. Municipalities desiring to engage in the sale of such energy may contract for its purchase with the commission and then dispose of it at retail under the jurisdiction—and the sole jurisdiction—of the Conservation Commission. If a central-station company is already in the local field, the municipality may enter into a contract with the company to act as its distributing agent, but is not compelled to do so. Likewise it may purchase the local company's system, for distribution purposes, under due process of law, but again is not compelled to take such a course. Finally, the municipality may reject both of the foregoing plans and construct its own system, thus entering into competition with the local company.

Clearly enough, the local company may exercise its own discretion in the matter of contracting with the municipality to act as a distributing agent of the State's hydroelectric energy, but it is powerless to prevent the purchase of its system, if the voters of the district so decide, and is equally powerless to prevent the municipality from building its own system and competing for local business, whether justified or not.

Taking up the first case, it is not difficult to foresee complications and resultant clashes of authority between the Conservation Commission and the Public Service Commission. Consider at once a company serving several municipalities, with a plurality of generating stations and tie lines and an extended distribution network. The bill would give the jurisdiction over rates and service in the case of customers served with the State's energy to the Conservation Commission, while customers served from the company's own plants would be served at rates fixed by the Public Service Commission. There might obviously be difficulties in deciding whether a customer served from a network received energy from the State's plants or the company's plants, and the source of supply might vary at different times, according to a variety of circumstances not under full or even partial control. Any company which entered into such a contract would face the practical necessity from a commercial standpoint of leveling its rates over the whole system. Thus, if the Conservation Commission fixed rates lower than those sanctioned by the Public Service Commission, the former would have to be generally adopted in order to avoid discrimination. There might be differences, moreover, in the standards of service fixed by the two commissions which it would be difficult or perhaps impossible to reconcile.

Equally grave, from the standpoint of the investor in the securities of the companies, is the prospect, if the bill becomes law, of enforced competition from a separate distribution system under municipal ownership and under jurisdiction as to rates and service of the Conservation Commission. Clearly the latter could fix rates below those approved by the Public Service Commission, with detriment to the private company, and even under equal rates there would be competition from the municipal system regardless of the necessity for it. Under existing conditions a public-utility company is protected to the extent that no competing company may enter the field without the approval and permission of the Public Service Commission.

In theory the intent of the present law is that unnecessary or unwarranted competition shall be avoided, that is to say, when the company already serving the community does so at the lowest reasonable rates and serves all the consumers which it can reach at a reasonable profit.

Enforced competition under municipal ownership, with no check upon public caprice in rushing into such a situation, and with the competing rates and service under full control of a separate regulating body, presents a possibility which may well alarm the investors in the properties now under private ownership serving the communities of the State.

Analysis of Proposed New York Barge Canal Water-Power Plans

A presentation on the proposed state water-power development of the New York Barge Canal at the Crescent and Vischer's Ferry dams, analyzing and pointing out the shortcomings of the plan as promulgated, has been addressed to the conservation committee of the State of New York by the public policy committee of the National Electric Light Association, of which Mr. Arthur Williams, of the New York Edison Company, is chairman.

This analysis points out that, although the commission's engineers propose developing from 12,000 hp to 36,000 hp, an actual survey of the water conditions will show that 12,000 hp would be available only 175 days of the year, owing to periodic low water and excessive flow. For a maximum yearly capacity the falls can be relied upon for only 6000 hp, which is equivalent to less than 4000 hp delivered at the consumers' premises.

For this initial development the commission proposes to spend $625,000. Placing interest at 4 per cent, sinking fund at 1 per cent, depreciation at 6 per cent and loss of taxes at 1.5 per cent, the total annual fixed charge reaches 12.5 per cent. The annual cost of the development, omitting labor, repairs and supplies, therefore becomes $78,000, or more than $19 for each hp-year available by the customers. These figures include only cost of transmission and omit the distribution plant at the cities to be supplied.

Although costing $19 per hp-year, it is proposed to sell this hydroelectric energy in the capital district for $7 or $7.50 per hp-year. In addition to this, as a member of the Conservation Commission has publicly advocated, it is the intention to build a large steam plant to supplement the water-power. For this steam plant an investment of at least a million dollars would be required. Including distribution expenses the fixed charge per hp-year at once amounts to $40, including nothing for labor, supplies, repairs or steam-plant fuel.

The Barge Canal was built entirely from state funds, the presentation goes on to state, so that therefore it is less than fair that the facilities obtained at such large cost should be appropriated by and devoted to cheapening the power service of a comparatively few, thus placing local manufacturers in a position of controlling advantage. The committee points out that since the dams belong to the public, any income derived therefrom should be devoted to the entire State, for the reduction of general taxation, which means that the privileges should be sold publicly, and without any favoritism, to the highest bidder.

Enormous sums of money are already invested in the State's public utility corporations, whose service generally is adequate and their prices reasonable. More than

$1,200,000,000 of private capital is now invested in the State's utilities, returning about $18,000,000 to the general welfare of the commonwealth. In conclusion, the committee points out that for the $625,000 appropriation asked it is proposed to develop hardly more power in the capital district than is required by one of the larger single office buildings of New York City. This power will be developed at a loss to the entire citizenship, in credit upon their taxes and in additional loss through increased taxes to make up deficiencies in the proposed service, while there will be set in motion a policy which cannot but be most destructive to the State's great vested interests.

The committee recommends that, instead of the proposed measure, legislation be enacted if necessary to permit the sale of this and other state water-powers (or at least this power as an experiment) at public auction, to the highest bidder, or their lease upon the most favorable terms, using as a minimum those adopted by the national government, and with the understanding that the operator, whoever he may be, shall be subject to the lawful control of the Public Service Commission.

Operation of the Ontario Hydroelectric System

In the report of Chairman Adam Beck of the Hydro-Electric Power Commission of Ontario, recently submitted to Sir John Morison Gibson, Lieutenant-Governor of Ontario, much valuable information is given concerning the design features and operating characteristics of the transmission and distributing system installed by the commission throughout the Province. This system was fully described in our issues dated Jan. 6, 13, 20 and 27, 1912.

According to the report the actual operation of the system was attended with certain difficulties at the beginning. A number of interruptions were caused due to changes in the adjustments of the line cables and ground wires, particularly during the winter months when it was difficult to readjust the cables satisfactorily. This trouble was confined to two sections of the line, but since these have been carefully gone over the interruptions of the high-tension lines resulting from windstorms have ceased, and very little trouble is anticipated from these causes in future.

It is also interesting to note that out of the 120,000 high-voltage insulator sections on the line not one has been broken from electrical causes since the beginning of operation, although a few sections were broken during the first few months by rifle bullets.

Because of the proximity of the telephone wires to the high-tension transmission cables large currents are induced in the telephone wires whenever a change occurs in the electrical conditions on the transmission circuits. The telephone apparatus would be frequently destroyed if some provision were not made to lead these heavy circuits to the ground. Difficulty was first experienced with the burning out of the fuses in series with the telephone instruments and the fusing of the heat coils which were later tried. The failure of these protecting fuses always occurred at times when the telephone circuits were most needed and frequently necessitated the employment of the Bell service to conduct the ordinary switching operations at the various stations.

Another difficulty which was also encountered at this time was the fouling of the lightning arrester gaps, which were composed of two blocks of carbon separated by thin strips of mica. The discharges across the arrester gaps were sufficient to dislodge particles of carbon from the blocks and bridge across the air gap. The result was either a ground on one side of the line or a complete short-circuit. Small vacuum-type arresters were then tried, but it was found that the induced currents were so heavy that the arresters would soon deteriorate and become useless. Bleeding coils submitted by one or two telephone manufacturers were also found inadequate. Finally, one of the commission's engineers designed an entirely new protective equipment which has been found very satisfactory in handling these large circuits.

In addition to the ordinary relays provided at each of the stations for opening the circuit-breakers when overloads or any similar troubles occur, use is made of special sets of line relays designed to cut out faulty sections of the high-tension lines automatically without interfering with the energy supplied to any of the other stations. The use of a relay system of this type is made possible through the loop scheme of distribution which is employed throughout the transmission system between Niagara Falls, Toronto and London. The western portion of the system embraces a loop starting at Dundas and extending to London, via Woodstock, and back to Dundas through the municipalities of St. Mary's, Stratford, Berlin, Preston and Guelph. Thus, Guelph may be supplied with energy around the loop from London instead of from Dundas directly, in case the Dundas-Guelph section of line is out of service. Line switches have been provided at each of the above-mentioned stations which make it possible to cut out of the circuit any section of line between two stations by opening the proper switches at those stations.

The line protective relays are employed to open the two switches at either end of any section out of service, as just described. The operation is accomplished as follows:

The small copper conductors are carried on the telephone poles parallel to the high-tension lines and provide an electric circuit between adjacent stations and connected to the low-tension windings of series transformers which are carried back on the lower ends of the high-tension oil-circuit-breaker bushings.

The low-tension windings at each end of any section are connected in series with each other and force a current through the relay wires proportional in value to the current in the high-tension line conductors, so long as the high-tension line is in normal operating condition. Should a fault occur on the high-tension line the current which flows in at one end of the high-tension line section will be different from that which emerges from the other. The difference will result in different current values in the low-tension windings of the series transformer at either end of the line and naturally disturb the current in the relay wires. The series transformers are provided with a tertiary set of windings, which are connected to the trip coils of the respective oil circuit-breakers. The different current values in the secondary windings of the series transformers tend to produce a potential in the tertiary windings sufficient to produce current in the trip coils and thereby open the circuit-breakers. This operation is accomplished at both ends of the line section simultaneously, and the section is instantly cut out and rendered harmless.

In view of the interest being manifested at the present time in the proposed hydroelectric system for the State of New York, the omission from the report of records of the finances involved in the operation of the Ontario system is noteworthy. The report contains many data as to the cost of the electrical equipment in various localities, but presents no facts as to the cost of operating the system or the revenue derived therefrom.

New England Power Album

The New England Power Company, the Connecticut River Power Company and the Connecticut River Transmission Company, a group of hydroelectric systems under the management of Chace & Harriman, Inc., of Boston, Mass, have issued a handsome 10-in. x 16-in. album describing the extensive developments of this group of properties in the Connecticut and Deerfield River valleys. The album contains a bird's-eye view in colors of the generating plants,

reservoir and dam installations, transmission lines and principal cities and towns of the companies' territories, a map of the combined high-tension system, a printed description of the present and proposed developments, and about a score of photographic reproductions of the more important engineering features of the enterprise, which were fully described in the Dec. 28, 1912, issue of this paper. The ultimate yearly output of the system through the interconnected operation of its completed plants is estimated at 300,000,000 kw-hr.

The Production and Distribution of Energy

In his address before the Franklin Institute, Philadelphia, March 19, Mr. Samuel Insull, president of the Commonwealth Edison Company, Chicago, presented carefully considered data and arguments to show that the electrical demands of scattered communities and their related agricultural and industrial regions can be served most economically and to the best advantage of all parties from a unified interconnected transmission network. Furthermore, he demonstrated that the lighting and motor service of the towns, water-works pumping, ice-making, interurban electric railway operation, farm applications, drainage pumping, and mine working—to say nothing of the future electrification of trunk-line railroads—offer loads for the countryside distribution system rivaling in diversity, load-factor and magnitude some of the most favorable conditions enjoyed by the great urban central-station systems.

Commenting first on the advantages of interconnected operation for service to towns, Mr. Insull cited data on the Lake County district where a number of individual stations were replaced by unified service, effecting a decrease in production costs from 7.08 cents per kw-hr. to 2.87 cents per kw-hr., a saving of 4.21 cents per unit. During the conversion to combination supply the region underwent a growth in population from 39,000 to 100,000 inhabitants, meanwhile increasing, however, its energy consumption per capita from 40 kw-hr. to 85 kw-hr. Although the connected load increased from 1438 kw to 3537 kw, the peak rose only from 415 kw to 765 kw, while the load-factor improved from 14.6 per cent to 28.9 per cent. The average price of energy was incidentally decreased from 9.4 cents to 7.7 cents per kw-hr.

Off-Peak Uses for Energy

Interurban railways can profitably purchase their energy supply from the local central-station system. Load curves exhibited by Mr. Insull showed the character of such railway power demands. Water pumping affords another long-hour utilization, with optional interruption during peak periods. Somewhat similar load conditions prevail with electrically operated ice factories, which present, in addition, a desirable annual load curve with reduced winter-month demands. The 1635 hp of motors installed in the electrically operated Chicago ice plants have an average load-factor of 42.7 per cent. Electric pumping for the drainage of farm lands also offers an off-peak use, of the order of 23.2 kw-hr. per acre.

In the State of Illinois the electrification of coal mines presents another great central-station opportunity. Mines already electrified show a consumption of about 1.63 kw-hr. per ton of coal produced, and at least 50,000,000 tons are now mined annually in the State. While the load-factors of individual mines may not rise above 20 per cent, their element of diversity gives combined a load-factor of about 25 per cent. As the miners quit work at 4 p. m., this service is essentially off-peak in character.

For conservatism, Mr. Insull based his farm figures on a use of only 2.5 kw per acre of land, although he declared his belief that average farm consumption would reach more nearly 5 kw per acre. The load-factor for this service he estimated at 35 per cent, based on existing installations.

Factors of Combined System

Combining the various loads above enumerated, curves were shown illustrating their diversity of demand with respect to both the hours of the day and the months of the year. A diversity factor of at least 35 per cent is thus made available between the primary generation and transmission system and the customer's service. The load-factor of such a system would be 48.7 per cent.

Touching on the future possibility of trunk-line electrification of steam railroads, the speaker referred to the economic value of obtaining energy for such use from power lines already gridironing the countryside, although he predicted that railroad electrification in the Middle West will follow after both terminal electrification of city stations and yards and trunk-line equipment in the more densely populated Eastern States. But railroad loads would affect only slightly the results otherwise obtained by combining the country demands, except to increase the diversity.

Saving in Investment and Operation

A survey of central-station plants in small Illinois towns has shown that the equipment reserves carried range from 15 to 82 per cent. Even despite the latter expensive provision, the reliability of such small-town service is always questionable.

Although the maximum demands of the various uses above described total 305,000 kw, the simultaneous maximum load on a unified system reaching these customers would be but 225,000 kw. Such a system would show a load-factor of about 48.7 per cent.

Replacing the 437,530 kw in small-plant capacity necessary to furnish the indicated service, with a unified system (allowing 20 per cent capacity reserve above the 225,000 kw of maximum demand), a saving is shown as follows: 437,530 kw in small plants, at $100 per kw, $43,753,000; 270,000 kw, unified, at $75 per kw, $20,250,000; making a saving in investment of $23,503,000.

In addition to this tremendous saving in plant investment, there will be similar economies in operation, although it would be difficult to give a fair estimate of these without assuming special conditions, for under conditions of individual-plant operation it is hardly conceivable that there could be obtained, either at all or on anything approaching a similar scale, such applications of electric service as unified operation makes possible.

Centralized Production Always Most Economical

This fact alone presents one of the strongest arguments that the central-station business can be successfully run only as a monopoly. A study of central-station economics similarly offers the best evidence against the municipalization of power plants and systems. The investment of taxpayers' money in relatively small electrical undertakings, whether in small towns or great cities, declared Mr. Insull, is waste of the worst kind. Whatever use is ultimately made of the energy, it can always be produced most economically under unified conditions, a conclusion reached by study of the conditions of both urban and rural service.

Mr. Insull predicted the day when every corner of the country where density of population justifies it will receive its general central-station supply for small towns and farming districts. Under certain conditions, he also declared, it might be more economical to transmit energy directly to cities from mine-mouth generating plants than to haul coal.

In concluding his remarks with an eloquent appreciation of the central-station man's opportunities and duties, Mr. Insull declared that had Lord Macaulay lived to witness the present era of electrical development he might have amended his famous statement to include among inventions which, abridging distance, have conferred the greatest benefit on mankind, the printing press alone excepted, "those which enable us to carry energy for the use of remote towns and country districts."

Report on Connecticut River Hydroelectric Development

In a report to the Massachusetts Legislature the Connecticut Valley Waterways Board recommends the construction of a channel 12 ft. deep, with corresponding locks, between Hartford, Conn., and Holyoke, Mass., and the establishment of extensive hydroelectric developments for the benefit of the cities and towns of the central Connecticut Valley. The report favors the charging of a federal rental from any corporation authorized to develop commercial power from the river at any point between its mouth and the Holyoke dam, thus indorsing the principle most strongly opposed as a violation of state's rights in the recent Congressional debates on the Windsor Locks bill.

The report includes broad recommendations for the study of the power and navigation possibilities of the river by commissions representing the State; for State appropriations to be used with those of Congress in making the most of these possibilities, and for co-operation with New Hampshire and Vermont to conserve the headwaters. An important recommendation is that in case any corporation authorized by Congress to develop power at Windsor Locks, Conn., should fail to carry out its task, the work may be undertaken by the States of Massachusetts and Connecticut, after an investigation and report by the Massachusetts Harbor & Land Commission acting jointly with representatives of the State of Connecticut.

Investigation Into Sale of Energy from Roosevelt Dam

In the report of its investigation of the Salt and Gila Rivers in Arizona and the related Indian reservations and work of the Reclamation Service, the House committee on expenditures (Hon. James M. Graham, Illinois, chairman) submitted some pointed criticism of the water-power negotiations entered into by the Reclamation Service with the Pacific Gas & Electric Company of Phoenix, Ariz. The report is based upon an investigation by the sub-committee, made up of Messrs. Walter S. Hensley, of Missouri, chairman; Oscar Callaway, of Texas, and Louis B. Hanna, of North Dakota, who visited Phoenix in April and May, 1912, to make a first-hand investigation of conditions.

The Indian interests, the report declares, have been outrageously intermingled with the affairs of the Reclamation Service; consequently the appropriations and uses of waters of the Salt and Gila Rivers appropriately formed the bases of the present investigation. Suspicion is directed by the committee against the business transactions between the Reclamation Service in Arizona and the Pacific Gas & Electric Company of Phoenix, the local utility corporation.

Although it was originally declared that electricity from the Roosevelt Dam would make Phoenix "the power city of the world," the various local commercial bodies waited until April, 1908, for some basis of fulfilment upon which to boom their community as a manufacturing center. About this time they received an intimation that negotiations were in progress between the Reclamation Service and the local corporation. On appealing to the Secretary of the Interior, it was found, however, that a contract had already been entered into on June 22, 1907, almost a year before. By the contract, Mr. Lewis C. Hill, for the Reclamation Service, agrees to furnish electrical energy from the Roosevelt Dam to the Pacific Gas & Electric Company at Phoenix for a term of ten years, during which period the government will refrain from retailing power to anyone in Phoenix and from furnishing power to others who would again sell or retail it. The corporation thus received a monopoly of the Roosevelt Dam power in Phoenix, excepting that factories might be permitted to purchase for their own use blocks of 100 kw to 500 kw or more. At the time this contract was entered into, it is also declared, a brother of the local manager of the electric corporation was engineer for the Reclamation Service in charge of the electrical development at the Roosevelt Dam. Protests were made to President Roosevelt and Secretary Garfield by many local organizations, including the Arizona Legislature, but no replies were received for a year.

The Pacific Gas & Electric Company by the terms of its contract paid 1.5 cents per kw-hr. for its energy and retailed it to domestic users at 20 cents per kw-hr. After many protests this price was reduced to 15 cents and finally to 12 cents. The company, however, capitalized its exclusive contract at $515,000.

Among other expedients to reduce electric rates in Phoenix a movement for a municipal lighting plant was started, which, although receiving the necessary two-thirds vote, was finally defeated by the failure of the enabling act required from Congress. Among the purchasers of electrical energy from the local company is the government Indian school, which has a monthly electric bill of from $300 to $500.

Mr. Hill testified before the committee that the predecessor of the Pacific Gas & Electric Company, the Phoenix Light & Fuel Company, had a contract with the Arizona Canal Company by the terms of which it was entitled to a monopoly of the water-power sites below the Arizona Dam. He further stated that he gave the contract objected to in exchange for this alleged right of the Phoenix Light & Fuel Company.

The report declares, however, that the Arizona Dam had been washed out and that the Arizona Canal Company was in bankruptcy, having had a foreclosure proceeding instituted against it. Experts who had examined the proposed power projects given to the Phoenix Company had, it is said, declared them worthless. The committee also insists that Mr. Hill and his associates persisted in overlooking the act of Congress authorizing the generation of power, in which it is provided that municipalities shall be given preference in the purchase of such energy. The majority report of the committee expresses the belief that action should be taken by the officials of the government, either through the courts or otherwise, looking to the setting aside of this illegal contract and that the Department of Justice should institute such criminal proceedings as the facts warrant.

In the minority report filed by Messrs. F. E. Mondell, of Wyoming, and Charles H. Burke, of South Dakota, the opinion is expressed that if a general investigation of the Reclamation Service be necessary, it should be undertaken by a commission familiar with irrigation laws and practice, and with conditions in the West. The minority report also points out that the apportionment of charges under all reclamation projects is a matter of discretion with the Secretary of the Interior. The report, No. 1506, was submitted Feb. 11, 1913, and has been printed in full.

Increase in Electric Trucks in Chicago

On the first day of the present year 523 electric trucks were in service in Chicago, or on order. In the following seventy days of 1913, ending with the middle of March, eighty additional trucks were placed in service, bringing the total number up to 603. On the first of January of the preceding year, 1912, it is estimated that not over 270 trucks were in use in the Western metropolis, indicating that during last year the total number of commercial cars was increased by about 100 per cent.

Local interest in the rapid growth of the electric-truck and delivery-wagon service has been stimulated by the "electro-truckometer," a humorous little scale device for recording the number of trucks in service, improvised by Mr. D. C. Arlington, Chicago representative of the Phila-

delphia Storage Battery Company and statistician of the Chicago Section of the Electric Vehicle Association of America. On a graduated scale like a thermometer card a blank column is left for marking in the increase in vehicles until a total of 1000 shall have been reached.

B. J. Arnold on the Chicago Traction Situation

In response to a request for the co-operation of the Board of Supervising Engineers, Chicago Traction, Mr. Bion J. Arnold, chairman of the board and its representative, appeared on March 7 before the sub-committee of the local transportation committee of the City Council of Chicago. This sub-committee is endeavoring, with the aid of the corporation counsel, to frame a tentative ordinance providing for the merger of all the surface and elevated-railway companies in Chicago. Mr. Arnold gave the sub-committee, in writing, some of the opinions and conclusions at which he has arrived as the result of his experience in administering the famous traction settlement ordinances of 1907, as it is probable that these ordinances, now in operation nearly six years, will be taken as the basis of the new ordinance providing for the merger. These ordinances, drawn up largely by Mr. Walter L. Fisher, consulting with Mr. Arnold, marked a departure in contract ordinances with public-utility corporations, and Mr. Arnold's analysis of them, after his intimate experience with their actual operation, is of great value.

Mr. Arnold makes it clear that he has no personal interest, or, rather, no selfish interest, in the matter. He makes the following interesting statement as to his own compensation: "So far as my own compensation, which was fixed in the ordinance [$15,000 a year as chairman of the board and $15,000 a year additional while chief engineer], is concerned, it will perhaps be sufficient to state that my income was for several years prior to my connection with the board, and when I was able to give my entire time to my professional work, over four times the total compensation which I now receive from the board. My only reason for retaining a connection with the board for some time past has been the fact that I felt a moral obligation to the public and the railway companies represented by the board to hold the position long enough to be instrumental in firmly establishing the principles of the ordinances, for it should not be forgotten that, by the terms of the ordinances, I do not directly represent either the city or the companies, but act as an arbitrator between them. I believe that it was the intention of those who wrote my name into the ordinances that I should see that equity was done for both sides, which responsibility I firmly believe I have faithfully discharged up to date."

During its six years of existence the Board of Supervising Engineers, created by the 1907 ordinances, has supervised the expenditure of over $80,000,000 for the rehabilitation of the surface street-railway properties. The city has received about $10,250,000 as its share of the net profits of operation during this period. The companies have received an average of 7.4 per cent on their investment, while the city's 55 per cent of the "net divisible receipts" has amounted to 7 per cent of the companies' gross receipts. The supervision of the entire work has been done by the board at an expenditure of about 1.6 per cent of the cost of the work constructed.

Mr. Arnold goes through the ordinance section by section and comments on it as a basis for the proposed merger. He recommends that in the future span wires be attached to buildings, where practicable, doing away with poles. Not less than 16 per cent of the gross receipts should be devoted to maintenance and renewals. The chairman of the board goes into the financial aspects of the discussion at considerable length. In the distribution of income he is inclined to favor the establishment of a contingent reserve fund for "lean" years or emergencies. This fund might take care of the amount to be set aside for amortization in poor years. As to guaranteed rate of return, it is questionable whether this should be raised from the 5 per cent specified in the present ordinances to the 7 per cent asked by the companies seeking to merge. The board of control, whatever its name, should be non-political. On this point Mr. Arnold says: "The independence of the balance of power of this board from local politics and from traction influence is the crux of the entire traction situation."

Effects of Recent Sleet Storm Near Chicago

Further reports in relation to the effects of the severe sleet storm of Feb. 21 (see *Electrical World* of March 1, page 437), are of some interest. The greatest severity of the storm, so far as overhead electric wires were concerned, was experienced in northern Illinois. The Public Service Company of Northern Illinois, which operates in the northeastern part of that State, was considerably hampered by the breaking down of wires. This was due not so much to the failure of poles, for the company's records show that only nine poles went down, as to the breaking down of the limbs of trees. The ice-laden branches fell on the wires, short-circuiting the latter and burning them off, or else

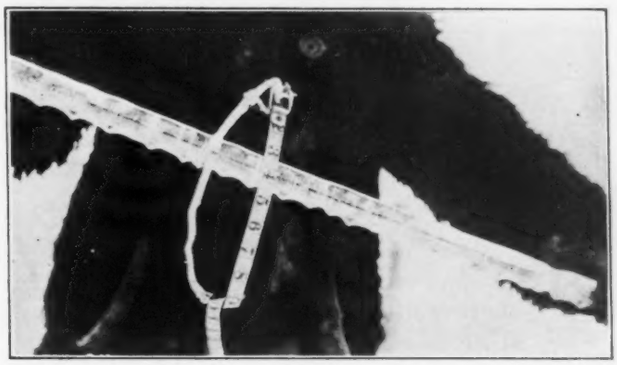

FIG. 1—TELEPHONE WIRE COATED WITH 1½ IN. OF ICE

breaking down the wires entirely by the weight imposed upon them.

Of the nine poles of the Public Service Company that went down, eight were near Crystal Lake and one in Oak Park. Considerable trouble was experienced by the lack of communication between the different parts of this extended electric-service system, owing to the failure, or partial failure, of telephone and telegraph service. Thus, a 20,000-volt circuit leading into a temporary substation at Crystal Lake was shut down to repair ice damage at the substation. The trouble was remedied in twenty minutes, but when an effort was made to telephone to Barrington substation to have the high-tension circuit put into service the telephone wires were found to be useless and there was no way of resuming service until a man could get over by train, several hours later. The effects of the storm as experienced by this company were most severe in Oak Park and Joliet, Ill.

The Chicago Telephone Company and the Central Union Telephone Company, which are operated conjointly, experienced severe loss from the storm. They report that trouble was experienced on Feb. 21 and 22 in the northern part of the State of Illinois from Wisconsin line as far south as La Salle. The two companies lost about 2500 poles. In a few cases there was as much as 2 in. of ice on wires, but this was exceptional. A view is shown of a telephone wire surrounded by a coating of ice about 1.5 in. thick as shown by the tape-line measurement. It was not only the weight

of the ice that caused the damage; the velocity of the wind was responsible for it to an equal if not a greater extent. Local damage to telephone circuits was particularly noticeable in Aurora and Elgin; there was not a great deal in the city of Chicago. Farm lines in particular suffered injury. Emergency service was established by rigging jury lines on the stumps of broken poles or else by laying emergency cables.

Men for the repair gangs were obtained from various places throughout the State. Few new men were hired, but the construction forces of the companies were concentrated at the places where their services were so urgently needed. The repair gangs are entitled to great credit for cheerful and effective work under discouraging conditions. Mr. L. C. Jones, plant superintendent for the suburban division of the Chicago Telephone Company, and Mr. H. B. Lewis, plant superintendent for the Central Union Telephone Company, were in charge of the work of rehabilitation. Service to practically all points in the territories of the two companies had been resumed by the morning of Feb. 25.

In Elgin, Ill., owing to the storm troubles of the Aurora, Elgin & Chicago Railroad Company, which supplies electrical energy in that city, there was no outside source of electricity available to operate the exchange of the Chicago Telephone Company. An alarm was sent out and there was shipped from the Chicago office, 38 miles away, the emergency electric generating outfit kept for such service.

FIG. 2 — CHICAGO-MINNEAPOLIS TELEPHONE LINE NEAR M'HENRY, ILL.

FIG. 3—ONE TELEPHONE POLE THAT STOOD WHEN ADJOINING POLES FELL

This set consists of a 5-hp gasoline engine directly connected to a dynamo rated at 50 amp and 30 volts. The unit is mounted on a wheeled truck and weighs about 2500 lb. It was shipped to Elgin and on arrival there connected to the power board of the exchange in time to supply the electrical energy for battery charging and other purposes.

Informal reports from the American Telephone & Telegraph Company show that the storm was localized within a radius of about 100 miles from Chicago, principally west and north, although comparatively slight damage was reported from a small area in Michigan south of Grand Rapids. In this region the long-distance company lost about 1200 poles and nearly all its lines were affected. As is well known, the standard of its overhead construction is very high. Service was recovered by the use of emergency cables principally, and it was restored practically to all points by the night of Feb. 23. Engineers for this company estimated the velocity of the wind as from 45 to 50 miles an hour. Experiments are being made by this company with concrete poles, but even if the poles were made so strong that they would not break down under a sleet storm the wires would probably be stripped off the poles. There seems to be no practicable way of obviating occasional damage to overhead wires from sleet storms except by going to the very great expense of burying the wires.

Annual Report of the American Telephone & Telegraph Company

The annual report of the American Telephone & Telegraph Company for the year ended Dec. 31, 1912, was made public this week. As in former years, it contains, in addition to statistics showing financial and physical growth, a comprehensive review of the company's attitude on the questions of public policy and public service regulation. It also discusses in considerable detail the relations of the company with state boards and the Interstate Commerce Commission.

Attention is called in the report to the progress made during the year in the field of telephone engineering, to the many welfare plans which the company has put into effect for the benefit of its employees, and to the satisfactory status of the individual companies, the American Telephone & Telegraph Company, the Western Union Telegraph Company and the Western Electric Company.

TABLE I—BELL TELEPHONE FISCAL STATEMENT

	1912	1911	Increase
Gross earnings	$199,172,154	$179,477,998	$19,694,156
Expenses—operation	$65,246,677	$60,085,425	$5,161,252
Current maintenance	31,762,636	30,184,522	1,578,114
Depreciation	34,942,802	28,655,832	6,286,970
Taxes	10,333,349	8,965,922	1,367,427
Total expenses	$142,285,464	$127,891,701	$14,393,763
Net earnings	$56,886,690	$51,586,297	$5,300,393
Interest	14,205,365	13,610,860	594,505
Balance net profits	$42,681,325	$37,975,437	$4,705,888
Dividends paid	29,460,215	25,966,876	3,493,339
Surplus earnings	$13,221,110	$12,008,561	$1,212,549

The statement of earnings and expenses for the Bell system in the United States for the year 1912 compares with that for 1911 as shown in Table I herewith. The statement shows a gain in gross earnings of nearly $20,000,000 over those in 1911 and an increase in total expenses of $14,393,763, reducing the increase in net earnings to $5,300,393.

TABLE II—COMBINED BALANCE SHEET, BELL SYSTEM, DEC. 31, 1912–1911

	1912	1911	Increase
Assets:			
Contracts and licenses	.....	$2,943,381	$2,943,381*
Telephone plant	$742,287,631	666,660,702	75,626,929
Supplies, tools, etc	23,601,262	20,749,568	2,851,694
Receivables	37,700,623	32,916,127	4,784,496
Cash	35,729,037	41,878,140	6,149,103*
Stocks and bonds	84,942,265	66,777,231	18,165,034
Total	$924,260,818	$831,925,149	$92,335,669
Liabilities:			
Capital stock	$393,209,925	$379,727,832	$13,482,093
Funded debts	294,380,353	241,032,822	53,347,531
Bills payable	38,268,341	41,198,431	2,930,090*
Accounts payable	25,320,335	23,382,438	1,937,897
Total outstanding obligations	$751,178,954	$685,341,523	$65,837,431
Employees' benefit fund	8,845,000	.....	8,845,000
Surplus and reserves	164,236,864	146,583,626	17,653,238
Total	$924,260,818	$831,925,149	$92,335,669

*Decrease.

The net earnings of the American Telephone & Telegraph Company, as an individual corporation, were $37,907,644, which is an increase of $4,606,398 over those in 1911. The interest charges were $5,844,698 and the dividends, at the regular rate of 8 per cent, were $26,015,587, leaving a balance of $6,047,357. At the close of the year the outstanding capital stock was $334,805,700 and the bonds were $105,002,000. For the capital stock outstanding

there has been paid into the company's treasury, $356,732,218, or nearly $22,000,000 more than the par value of the stock. With all duplications excluded, the combined balance sheet as of Dec. 31, 1912, compares with that as of the same day in 1911 as shown in Table II.

A very careful appraisal conducted by the engineers of the physical property of the Bell system as of August 1 last showed that while the book cost was $736,000,000, the cost of reproduction at that date would have been $797,000,000. In other words, the company was carrying the property on its books at $61,000,000 below its actual physical value at the time of its appraisal. In this appraisal there were included no intangible assets whatever, such as good will, patents, franchises, cost of developing the business, etc. For the year, as above, there was an increase in assets of $92,300,000, of which $75,600,000 represented current additions to the plant, including the necessary real estate. During the five-year period betwen 1907 and 1912 the assets of the Bell companies have increased $311,000,000 while the capital obligations outstanding have increased only a little over $199,000,000. The surplus and reserves have increased from $61,300,000 to $164,200,000, or nearly $103,000,000, even after setting aside $8,845,000 for the benefit fund recently created for the employees.

Estimates of the construction requirements of all the operating companies and of the American Telephone & Telegraph Company for 1913 call for a total expenditure of about $62,000,000.

The steady decrease in revenue and increase in operating expenses per subscriber's station—a conspicuous feature in former years, referred to in previous reports—was checked in 1912, and slight gains over 1911 were shown.

A comparison of figures of revenue and expense per subscriber from 1895 to 1912 shows a decrease in that period of over one-half in the average cost to the subscriber for the service and of nearly that amount in the maintenance and depreciation as well as other expenses, leaving a net revenue per station of $9.29 in 1912 as against $23.52 in 1895. Average net profits on the investment have been but slightly affected, however, as the plant cost per station has decreased almost one-half.

Statistics given in the report show that at the end of the year the number of stations which constituted the Bell system in the United States was 7,456,074, an increase of 823,449, including 344,173 connecting stations. Of these, 2,502,627 were operated by local, co-operative and rural independent companies or associations having sub-license or connection contracts, so-called connecting companies.

The Bell telephone toll lines of the United States now reach 70,000 places, from many of which a telegraph message can be sent. The extent of the system is best realized by comparison with less than 65,000 post offices, 60,000 railroad stations and regular telegraph offices at about 25,000 places.

Including the traffic over the long-distance lines, but not including that of the connecting companies, the daily average of toll connections in 1912 was about 738,000 and of exchange connections about 25,572,000. This compares with 645,000 and 23,484,000 in 1911.

Other statistics in the report show that while Europe has three and a half times the telegraph traffic of the United States and nearly twice the first-class mail traffic, it has only two-fifths of the telephone traffic, which is attributed to the greater efficiency and distribution of the telephone service in this country.

Speaking of the distribution of the capital stock, the report says that scarcely any corporation in the United States has its capital stock more widely distributed than has the American Telephone & Telegraph Company. A majority of the shares are held by women and less than 7 per cent, the report says, is held in the name of brokerage houses. The average number of shares held by each stockholder at the close of 1912 was shown to be 66.

The report describes the new plan announced Jan. 1 last for employees' pensions, disability benefits and insurance, adopted by the American Telephone & Telegraph Company, by its associated companies, by the Western Union Telegraph Company and by the Western Electric Company. For the purpose of inaugurating these benefits the American Telephone & Telegraph Company made an initial appropriation of $2,000,000. There are about 200,000 employees —men and women—in the service of the companies concerned who will be directly or indirectly affected by this provision. The plan has been elaborately worked out and will, it is believed, result in the increased happiness and betterment of employees and prove a factor in obtaining and keeping those of high class.

As regards the engineering accomplishments of the year, after discussing many improvements which have been developed recently, standardized and placed in the plant equipment and service of the associated companies, President Vail says:

"Experience with the engineering devices and methods employed in the New York-Denver line having demonstrated their value under severe practical conditions, a systematic introduction of these improvements was undertaken and actively prosecuted throughout the United States, so that at the end of 1912 there was a total of 54,750 miles of the heaviest-gage wires equipped with the new arrangement, thus doubling their transmission efficiency, and in addition to this there were obtained, without any expenditure for new wires, phantom circuits equivalent to 12,600 miles of the heaviest gage circuit. These improvements have brought into communication with each other places formerly too remote, and between a great number of places less remote noteworthy impovements in the telephone service have been reported.

"Engineering plans have been completed for the extension of four heavy copper wires from Denver to San Francisco, and construction work is to commence as soon as the weather permits."

The report speaks of the fact that there are now in thirty-three states public service and other commissions which supervise the telephone service, and points out that this supervision is entirely distinct from that of the Interstate Commerce Commission.

It also contains a letter under date of Jan. 7, 1913, from the Attorney-General of the United States to the chairman of the Interstate Commerce Commission discussing at length the activities of the company and also the order made by the Interstate Commerce Commission as of Jan. 13 last directing that a thorough investigation be made "concerning the history, the financial operations, the rates, rules, regulations and practices of telephone and telegraph companies subject to the act to regulate commerce, with a view to the making of a comprehensive report and to the issuance of such order or orders as may be necessary to correct such discriminations and make applicable reasonable rates and practices."

The policy of the company, the report goes on to say, as in the past, will be to co-operate with the examiners conducting this investigation and to aid public officials in every possible way in their effort to ascertain the facts respecting the telephone service of the United States.

President Vail, in conclusion, makes this statement: "As to the future of the company, it was never brighter. Business indications are normal, and our relations with the public and with the public authorities are on a mutually satisfactory basis.

"The organization on the line set forth in previous reports is about complete, and the division of the work is so clearly drawn and so closely correlated between the local administration of the associated companies and the central general administration of the American Telephone & Telegraph Company that there is no duplication of effort or conflict in administration."

The Electric Vehicle at Boston

At the joint meeting of the Electric Motor Car Club of Boston and the New England Section of the Electric Vehicle Association of America held at Boston March 17 nearly 100 persons were present. There are now 104 members of the former club, and at the meeting it was voted to extend the radius of membership to points within 50 miles of Boston, which will enable electric-vehicle men at Worcester, Providence, Lowell, Haverhill, Malden and other important centers to take a more active part in the campaign. Hitherto the radius of membership has been about 5 miles, and while many of the central-station organizations outside Boston have from time to time been invited to the club meetings, their active influence has not been available.

The Boston Edison Company's interest in the work is as strong as ever, and the company is furnishing office space at 39 Boylston Street for the secretary of the club, Mr. O. G. Draper, who is now engaged in a vigorous campaign to concentrate the advertising of the electric-vehicle interests in forthcoming issues of representative Boston dailies. Mr. Draper announced that an inquiry from Durham, N. H., had resulted from the club's publicity work in the Boston press.

At the joint meeting which followed the usual dinner of the club Mr. Draper was elected permanent secretary of the New England Section also. Chairman Fred M. Kimball then called upon Mr. J. W. Cooke, of the Electric Storage Battery Company, Boston; Mr. H. H. Smith, of the Edison Storage Battery Company, Orange, N. J., and Mr. R. E. Russell, General Electric Company, Lynn, Mass., who presented lantern-slide talks on subjects of storage-battery operation and charging equipment.

The battery talk by Mr. Cooke reviewed the latest practice in the operation of lead batteries and included stereopticon views of a miniature cell group under charge and discharge conditions, an analysis of voltage and specific-gravity curves and experiments with a 120-amp-hr. cell, including short-circuit tests, temperature readings and output data. The point was made that the pasted types of plates now used in electric-vehicle service have twice as much capacity per unit of space as the former non-pasted type, besides recuperative powers of great value for trucks and pleasure cars. A momentary output of 1 hp for a 20-lb. cell was easily obtained in the test. Mr. Cooke showed that an iron-clad "Exide" battery of forty-two cells, with a total weight of 1500 lb., has a momentary discharge output of 75 hp without appreciable temperature rise. This point effectually disposes of the idea sometimes held that the storage battery is unequal to the requirements of motive power.

The present tendency is toward both discharge and charge at higher rates. A new electric locomotive to be built for the Boston Edison Electric Illuminating Company's use will have a momentary output of 150 hp, or ten times the normal rate of discharge. Emphasis was also laid upon the ability of modern batteries to receive noon "boosting charges" at high rates, a point of great value in industrial truck service. A good empirical rule is to begin charging at the quotient of the number of ampere-hours taken out of the battery divided by the sum of unity and the number of hours available for the boost.

Reliability features of batteries for operating self-starters for gasoline automobiles were also discussed. Mr. D. C. Tiffany, of the Rauch & Lang Company, Boston, cited the case of such a battery which shows no sign of wear after a year's use.

In discussing the Edison battery Mr. Smith outlined its characteristics and emphasized the rapid growth in its use evidenced by the present fourfold expansion of the factory. He cited various experiences with the battery in service resulting from the ignorance of certain users, one of whom poured acid into a cell in place of the usual alkaline electrolyte. Excellent service can be obtained from Edison cells in even the coldest weather, he said, provided the battery is protected against air circulation.

Insulation Problems at High Potentials

At the 281st meeting of the American Institute of Electrical Engineers, held at New York, March 14, under the auspices of the electrophysics committee of the Institute, papers were presented on the topics of "Air as an Insulator When in the Presence of Insulating Bodies of Higher Specific Inductive Capacity," by Messrs. C. L. Fortescue and S. W. Farnsworth, and "The Application of a Theorem of Electrostatics to Insulation Problems," by Mr. C. L. Fortescue. Following the technical session a smoker was held in the Institute rooms.

Air as an Insulator

In purpose, the paper by Messrs. Fortescue and Farnsworth pointed out conditions determining the disruptive strength of an air path along the surface of a solid dielectric of higher specific inductive capacity. This "creepage" breakdown is even less definite than the disruptive voltage of air alone, but the authors described methods by which the air and solid insulators can be used in combination to the best advantage. By means of an exploring electrode the shape of such fields may be plotted. The higher the specific inductive capacity of the material, the more detrimental will be any projection above the surface of the insulator. A groove in the insulating material will also introduce other unfavorable conditions. If, however, the dielectric surface be formed tangential to the lines of force at every point, the strength of the air path will be unchanged.

Practical examples were then given applying this theory to the case of a terminal rod passing through a casing. Curves presented showed the intensity at various points along the path. New designs of terminals have resulted from the application of the principle. For instance, by a very inexpensive change involving only the addition of a disk covered with tinfoil a certain terminal which could previously withstand only 300,000 volts had its strength increased to 575,000 volts without visible corona. This was accomplished by relieving stresses in the air at the top of the terminal and redirecting the field so that equipotential surfaces in the air were evenly distributed.

Based on the conception above outlined, commercial tests have shown that air can now be used as an insulator more efficiently than in the past. Breakdowns of an air path over a surface averaging as high as 9.4 kilovolts per cm or 23,900 volts per in. have been obtained over distances of 6.7 in. The conditions of design are such that these averages may be maintained at any voltage by increasing all dimensions of the structure proportionately. A maximum efficiency of air path will result from conformance of the dielectric surface to the flow-line between terminals. The strength of such a path is independent of the specific inductive capacity of the dielectric. By proper shaping of the terminals points of high intensity can be avoided, obtaining, instead, a high average intensity for the whole path.

An Electrostatic Theorem and Insulation Problems

If a region in any particular electric field be isolated or cut out by any number of closed surfaces, then the electric field in this region will remain unchanged, whatever change may take place in the external field, if the potentials of all points on the inclosing surfaces are maintained at their original value. By employing this principle of electrostatics, various conductors, as Mr. Fortescue showed in the second paper, can be arranged to help in insulating one another. Also, two or more regions separated from one another by any number of surfaces may each have a differ-

ent electric field if at every point of the dividing surfaces the fields in these regions have the same potential.

In practical applications of this principle, however, the means for producing uniform surface distribution are limited both by the finite number of steps to be employed and the necessary use of finite strips of metal. Core-type transformers can be insulated in this way. One such transformer so assembled was tested up to ten-second applications of a potential 573,000 volts above ground. With some changes the same system can be adapted to the needs of polyphase transformers and to shell-type transformers. Designs were also shown for various types of terminals, insulators, suspension disks, etc., employing the principle already outlined. From a comparative test of terminals of the improved type using both large and small disks, it was shown that whereas with the small disks 420,000 volts endangered the terminal, the large 5-ft. disk, 1 ft. thick and with semi-circular edges, exhibited no signs of corona up to 573,000 volts. The well-known guard-ring, as the paper pointed out, is another application of the same principle by which a given electric field may be maintained constant within an inclosed region, independently of the influence of other bodies. The principle, in fact, is one capable of wide application and seems to afford a solution of some of the most perplexing problems of high-potential design.

Discussion

Presiding as chairman of the electrophysics committee, Dr. J. B. Whitehead in opening the discussion commented on the close relation between electrical theory and practical engineering as exemplified in the two papers presented.

Mr. Percy H. Thomas emphasized the significance of the two principles, (1) paralleling the insulator surfaces to the lines of electrostatic force and (2) division of the dielectric into equipotential intervals by intermediate conductors, described in the papers. As far as the theory is concerned, the design of these insulating surfaces and spaces will be independent of the frequency, said Mr. Thomas. External fields, however, might have a disturbing effect. Owing to current leakage over the surface and the spreading of such leakage path near the mid-point, the speaker urged that the fall of potential along the path might be different from that resulting from the elestrostatic field. He also cautioned his hearers that a perfectly distributed condition of potential might be one most easily upset.

Mr. Ralph D. Mershon, in referring to creepage distances, pointed out that grooved surfaces on insulators aid in lengthening the surface path through dirt which may be present and thus increase the leakage resistance. After discussing theoretical conditions for very high frequencies, Mr. Mershon gave a brief account of Professor Ryan's experiments in California with frequencies as high as 1,000,000 cycles per second, at 35,000 volts. The presence of external conductors may have important practical significance, he suggested, in the case of transformers in small cells, etc.

Mr. C. O. Mailloux commended the great practical value of the evening's theoretical papers. The equipotential electrostatic envelope he likened to the form assumed by a blown balloon. Unequal bulges can be corrected for by applying a counter or balancing potential, thus maintaining the equipotential envelope on all sides.

Mr. F. W. Peek, Jr., compared electrostatic with electromagnetic phenomena. Electrical apparatus must be designed, he insisted, to meet abnormal as well as normal conditions, and arrangements theoretically accurate for the assumed conditions may fail badly when exposed to surges, lightning or other high-frequency stresses.

Dr. A. E. Kennelly commented on the demands being made by electrical engineering on pure mathematics. The second theorem, he suggested, was enunciated in the earlier discussion on the condenser-type terminals. The speaker suggested calling the electrostatic unit of flux the "kelvin," corresponding to the magnetic "maxwell."

Mr. Philip Torchio declared that the theorem applies not to high voltages of the order of 100,000 volts but to such moderate pressures as 4000 volts to 20,000 volts. He described tests of a cable in which interesting corona effects were obtained at pressures up to 42,000 volts. Mechanical cracking of the rubber insulation followed.

Mr. J. M. Weed questioned whether the fundamental proposition stated in the first paper holds for the field between parallel wires. In an insulating surface such as the one described, Mr. Weed declared that by flattening the curvature at the midpoint and shortening the radius near the electrodes the stress at the midpoint might be increased, at the same time reducing it near the terminals, and thus securing the most efficient distribution. The consequent reduction in path-length the speaker said he had confirmed by actual experiments. After such a change one surface assumed to be most efficient by the author's theoretical determinations was found to be improved 37 per cent. This result, commented Mr. Weed, emphasizes the necessity for caution in interpreting the deductions of theoretical analysis without confirming them by careful experiment.

Mr. L. W. Chubb pointed out that one of the ideal conditions for the improvement of the toroidal-and-rod body is the use of the dielectric medium as an insulator.

In closing the discussion, Mr. Fortescue declared that the occurrence of local corona at one point in a long path is not likely to become progressive in weakening and breaking down other sections of the path. He denied that because an efficient form of insulation is designed upon a theoretical basis it need necessarily be weak to high-frequency oscillations. Insulation methods have heretofore, he said, too often simulated in crudeness the rough log thrown across the stream by the savage. Mr. Weed's results, he suggested, were obtained with very small rings and rods whose surfaces were highly efficient since the corona point of air was increased by the small curvatures.

Lecture on Radioactivity Before A. I. E. E.

The first of a series of four lectures which will be delivered before the American Institute of Electrical Engineers by Prof. Edwin P. Adams, of Princeton University, on the subject of radioactivity was presented in the Engineering Societies Building, New York, on March 19, 1913. In introducing the speaker of the evening President Ralph D. Mershon called attention to the fact that this is the first lecture course to be given under the auspices of the Institute. He cited the fact that the general lack of knowledge of the subject of radioactivity among the engineering fraternity had led the electrophysics committee to take this means of presenting the subject to the members of the Institute and their friends.

The first lecture covered the following topics: the discovery of the properties of radioactivity, radium and its preparation, ionization of gases, and the nature of the radiations from radioactive substances—alpha, beta and gamma rays. The speaker assumed that the audience had no present knowledge of the subject and presented a general survey of the history and important results of radioactive research and their bearing on the electrical theory. Professor Adams stated that the original discoveries relating to the science of radioactivity were made about seventeen years ago and that up to the present time there had been prevalent a general impression that these discoveries tended to overthrow the established principles in electrical theory. The speaker said that it was the object of these lectures to point out wherein the old views were correct and valid and to show the application of the present discoveries to those theories.

In speaking of the effects produced by radioactive substances the speaker told of the radioactive effect upon a photographic plate which, although concealed from ordinary

light, is exposed to the rays from these substances, and he commented on the fact that the air in the neighborhood of the material emitting these rays is a partial conductor of electricity. It was stated further that one way of comparing the radioactive effects of two bodies is by making a comparison of the relative conductivity of the air in their vicinity.

The ionization of gases under the action of the rays from radioactive substances was explained by means of several lantern slides showing the paths of the alpha and beta particles as they leave the cathode and traverse the surrounding media. The paths were clearly marked and the points at which collisions with different atoms and molecules had occurred could be observed from the change in direction of the path of the particle. Although the alpha and the beta rays are deflected from their courses by magnetic or electric fields, it had been found that the gamma rays are not at all susceptible to the influence of either of these fields. The speaker gave some interesting figures concerning the relative velocity of the various rays as compared with the velocity of light and told of the experiments of Prof. R. A. Millikan and others who have succeeded in isolating ionic charges upon drops of water and oil and calculating the number of charges carried by the globules.

The remaining lectures of the series will be delivered by Professor Adams on March 26 and April 2 and 9 in the Engineering Societies Building.

Chicago Section, Electric Vehicle Association

At the luncheon of the Chicago Section, Electric Vehicle Association of America, March 11, topics of co-operation with the local garage owners' association and the establishment of a school for electric-vehicle chauffeurs and battery men were discussed briefly and plans outlined.

Referring to the subject of rates for garaging electric automobiles, Mr. E. E. Jones, of the General Vehicle Company, declared that no attempt should be made to set a flat rate on the storage of either pleasure or commercial vehicles, as such a rate is unfair to both the customer and the garage owner. Since Mr. G. H. Jones, of the Commonwealth Edison Company of Chicago, has offered to install separate meters in the garages for each vehicle, it was considered a better method to set a certain rate on floor space, another rate on the care of cars and batteries, and charge for the amount of electrical energy supplied to batteries according to the readings of the individual meters. As some owners of electric pleasure vehicles object to having their cars kept next to a commercial truck, it was suggested that commercial and pleasure vehicles be garaged separately.

May 6 has been set as the date for the annual meeting of the Chicago Section. Mr. Arthur Williams, of New York, president of the general association, is expected to be present at that time.

The Minnesota Convention in St. Paul

Accepting the presidency at comparatively short notice, Mr. Eugene Holcomb, of St. Paul, was the guiding spirit of a successful convention of the Minnesota Electrical Association held in the roof garden of the Hotel St. Paul, in St. Paul, on March 11, 12 and 13. The total registered attendance, about eighty, was not large, but interest was manifested by a good discussion of not too numerous papers. Minnesota has a large number of small municipal plants, and under the constitution of the association both privately owned and municipal plants are entitled to membership. The supply men were well represented, several concerns making exhibits. They entertained the operating men at a banquet.

In presenting the report of the executive committee, Mr. E. F. Strong, of Chaska, secretary-treasurer, stated that the resignation of President George Marvin, of St. Cloud, was accepted on Jan. 7 last. Mr. Holcomb was elected president at that time and Mr. R. F. Pack, of Minneapolis, was elected a member of the executive committee to fill the vacancy. Mr. Strong's report as treasurer showed that the finances of the association are in satisfactory condition.

President's Recommendations

In his presidential address Mr. Holcomb pointed out that the electric-service field is not even approximately covered as yet, as less than 20 per cent of city residences are supplied with electricity. But with the economical methods and appliances of to-day the business is going ahead by leaps and bounds. In the past some managers have handled their problems of economics in an unscientific manner, but the old order is passing. "The greatest good to the greatest number" should be the public-utility operator's motto. In relation to the affairs of the association, the president said that the members must devote more time and energy to the work if it is to count. There are about 200 electric-service plants in Minnesota, public and private, and about 37 per cent of these are represented in the association. The active membership is made up of about twenty-eight private plants and about thirty-six representatives of public plants, but nearly all the most important properties are represented. Mr. Holcomb pointed out an anomaly in the constitution by which publicly owned stations, as such, are apparently not represented. He said there should be a distinction between these two classes in the membership. A continuous performance and more permanency are also needed in the administration of the association. The executive committee should be a continuing body, and it should appoint the secretary-treasurer, who should be subject to the committee.

Messrs. H. J. Gille, of St. Paul; R. E. Brown, of Mankato, and T. C. Gordon, of Little Falls, were appointed a committee on the president's address. Later they indorsed the changes suggested by the president, recommending that suitable constitutional amendments be voted on at the next meeting.

Safety Engineering

Mr. Don D. Lescohier, an expert of the Minnesota State Bureau of Labor, Industries and Commerce, read a paper on "Prevention of Accidents." He spoke of accidents to linemen and to power-house employees and suggested remedies. While the number of accidents is large—too large—it is satisfactory to note that it is declining. Much interest was manifested in this subject. Messrs. Holcomb, Pack, Gille, A. Larney, of Minneapolis; A. H. Dickerson, of Windom; G. Fabianke, of Sherburne; Ludwig Kemper, of Albert Lea, and Strong took part in the discussion. A committee was appointed to consider pending legislation intended to enlarge the scope of the state bureau, but later it reported against taking immediate action.

The Manager and His Problems

Mr. Ludwig Kemper, of Albert Lea, past-president, read a short paper on "The Central-Station Manager." He dwelt on the necessity of tactful relations with customers. This paper brought out a discussion that covered a wide range. Among those taking part in it were Messrs. L. Peterson, of Thief River Falls; R. B. Wallace, of St. Paul; Dickerson, Gille, Holcomb, Thomas Pitts, of Hutchinson; E. T. Street, of St. Paul; Holmes Ives, of Redwood Falls; Brown, and E. A. Aspnes, of Montevideo.

Steam-Flow Meters

A paper on "Steam-Flow Meters" was read on Wednesday morning, March 12, by Mr. C. R. Matheny, of the Chicago office of the General Electric Company. Sarco, Sargent, St. John, "G. T." and General Electric meters were described, with lantern slides. Among other advantages of this refinement in boiler-room practice is its value in regulating feed-water input. Messrs. Aspnes, F. A.

Otto, of St. Paul; Kemper, Pitts, Wallace, and T. D. Crocker, of St. Paul, took part in the discussion.

DEVELOPING CENTRAL-STATION BUSINESS

Mr. R. F. Wherland gave an interesting illustrated talk on the business he has built up in distributing electrical energy in Redwood Falls, Morgan, Morton and other villages ranging from 1600 to 100 in population. These small Minnesota communities keep up to the times. For instance, Morton has a domestic science school where all the cooking is done by electricity. The average price received last year was 13.72 cents per kw-hr. for electrical energy developed by water-power, with oil-engine auxiliary.

A paper giving an instructive account of the manner of securing motor-load customers in Duluth, written by Mr. C. E. Van Bergen, manager of the Duluth Edison Electric Company, was read by Mr. George W. Gibeau, of the same company. Mr. Crocker opened the discussion, in which Messrs. J. C. Bang, of Madison; E. W. Erick, of Canby; Aspnes, Egbert Douglas, of St. Paul, and others took part.

CO-OPERATION WITH THE UNIVERSITY

"The University and the Central Station" was the title of a paper read by Prof. George D. Shepardson, professor of electrical engineering in the University of Minnesota. The author indicated how co-operation could be effected. Among other things he spoke of a "university week," to be given in various cities, during which lecturers from the university may discourse on electrical subjects, popular and technical, while the local central-station management conducts a "whirlwind campaign" for new business. Evening classes are now given at the university in eight electrical courses. The university also offers its facilities for testing apparatus. But its greatest function lies in training men.

EUGENE HOLCOMB

Mr. R. F. Pack, of Minneapolis, opened the discussion. As a central-station manager, he is heartily in favor of cordial co-operation between the university and the central-station interests. College men not too academic, with some idea of business and of the spirit of compromise necessary in the practical affairs of life, are needed. Mr. Bang, Mr. W. R. Rutledge, of Howard Lake, and Mr. Wherland also spoke on the subject.

DIRECT AND INDIRECT LIGHTING

"Modern Illumination" was the subject of a lecture given on Thursday morning by Mr. W. N. Goldschmidt, of the National X-Ray Reflector Company. The speaker explained and illustrated with lantern-slide pictures the indirect and show-window lighting systems of his company. In the discussion Mr. Wallace said a good word for direct lighting and added that shadows are not always objectionable. Mr. Goldschmidt answered that in a properly designed indirect-lighting system there was not an entire absence of shadows but an absence of grotesque shadows. Mr. Hogan, of St. Paul, rather favored the semi-indirect idea; "straight" indirect is rather cold and dead in effect. The author of the paper, referring to the efficiency of the semi-indirect system, said that the loss of light in passing through translucent material is as great as in reflection from a good ceiling. Mr. Gille declared his belief in indirect illumination, but said that the question was to interest architects and the public. To this the response was that a national advertising campaign was started by the X-ray company on Jan. 1 last. Mr. M. A. Pocock, of St. Paul, spoke of the necessity of redecorating ceilings in old premises for the indirect system and mentioned the practical difficulty in keeping the fixtures clean and therefore efficient. Mr. Goldschmidt retorted that the decorating and frequent cleaning were a benefit to humanity in a sanitary sense.

DIESEL OIL ENGINES DISCUSSED

Mr. E. A. Aspnes, manager and engineer of the Montevideo Electric Light & Power Company, gave a report of a test made by him on a 170-hp Diesel oil engine installed as an auxiliary in the municipal hydroelectric plant at Granite Falls on the Minnesota River. His conclusion was that the engine, installed in October, 1911, had not maintained its rated output and efficiency. On the other hand, Mr. Peterson, superintendent of the municipal plant at Thief River Falls, reported very satisfactory results with two engines of about the same size, also auxiliary to a water-power plant, in service for about a year. Mr. Kemper, of Albert Lea, expressed doubt of the advantages of this type of engine, pointing out the greater first cost compared with steam equipment, and the increasing price of fuel oil. Mr. Ives, of Redwood Falls, spoke favorably of the Diesel engine as an auxiliary in a water-power plant, speaking from experience. Mr. Rutledge, of Howard Lake, favored it in small units.

CONCLUDING BUSINESS

Mr. Rutledge brought up again the complaint made at last year's convention that manufacturers are selling incandescent lamps on consignment to hardware dealers in small towns, the prices being such as to put electrical operating men and dealers at a disadvantage.

A resolution was passed requesting the Legislature to make a suitable appropriation for the representation of Minnesota at the Panama-Pacific Exposition of 1915 in San Francisco.

On the report of a nominating committee consisting of Mr. B. W. Lynch, of Minneapolis, Mr. Otto and Mr. Aspnes, these officers were elected: President, Mr. Eugene Holcomb, St. Paul; first vice-president, Mr. R. E. Brown, Mankato; second vice-president, Mr. E. F. Strong, Chaska; secretary-treasurer, Mr. F. A. Otto, St. Paul; executive committee, Mr. Holcomb, Mr. Brown, Mr. Otto, Mr. H. J. Gille, of St. Paul, and Mr. Leonard Peterson, of Thief River Falls. Mr. Otto, it should be explained, was, despite his protests, put on the ticket by his fellow-members on the committee.

THE NEW PRESIDENT

Mr. Eugene Holcomb, who was elected president of the association, is vice-president of the Consumers' Power Company (controlled by H. M. Byllesby & Company) and general manager of the company's business in St. Paul. He has had an interesting career. Born near Grand Rapids, Mich., he evinced an aptitude for electrical work at an early age. While still a boy he removed with his parents to California and for a number of years thereafter he was identified with early transmission lines, arc-lighting plants and telephone installations. He was connected with both the Thomson-Houston and the Edison General company and built a number of electrical plants on the Pacific Coast.

In 1892 he became contract agent of the Portland (Ore.) General Electric Company, and two years later he organized the McCaskey & Holcomb Company, of Springfield, Ill., which operated the Capital Electrical Company's property under a lease. Here he rebuilt a number of 10-amp series arc machines to operate at 6.6 amp, with marked economy. In 1902 he sold out his Springfield interests and went abroad for the Westinghouse Electric & Manufacturing Company. In Argentina he built what were then two of the largest gas-driven electric plants in the world. Three years later he came back to this country and was placed in charge of all foreign sales of the Allis-Chalmers Company of Milwaukee. He became connected with the Byllesby interests early in 1910 and for over two years has been located in St. Paul, where he takes an active part in civic affairs. Mr. Holcomb is an alert, all-around American electrical man. He has taken out several patents, belongs to a number of technical societies and social clubs, has developed apparatus, sold goods and managed properties. His paper on "Central-Station Economies," read at the Byllesby convention in Chicago in 1911, was a valuable contribution to the literature of plant operation.

BANQUET AND ENTERTAINMENT

Manufacturers and dealers gave a dinner and vaudeville entertainment to the plant operators at the Hotel St. Paul on Wednesday night. Mr. H. J. Gille was toastmaster, and Mr. Archie M. Hayes, representing the Governor of the State; Mayor Keller, of St. Paul, and others made speeches. Professional performers entertained, and there were some interesting electrical decorations and "stunts."

Accident Compensation Costs in Massachusetts

In a special bulletin just issued the Massachusetts Industrial Accident Board cites that in the last six months of 1912, representing the first half-year of the board's service, there were reported 42,882 industrial accidents, and that not over 30 per cent of these represented injuries which disabled the employee for twenty-four hours or more. It is estimated by the board that the total payments for its first year, based on one-half the average weekly wage of employees killed or injured while in the course of employment, and including medical attention, hospital care and medicines, will be more than $2,000,000.

About 30 per cent of this amount will go to doctors and hospitals and 20 per cent to the dependents of those fatally injured, the remaining portion going to disabled employees.

This total of insurance benefits will net the injured wage earners of the State more than five times as much as they received in the year under the former employers' liability law, which was superseded by the workmen's compensation act of 1911. In the figures cited no consideration is given to the cost of insurance administration. As a result of a special investigation of eight representative concerns, employing 25,803 persons, the board concludes that as a whole the premiums charged for workmen's compensation are too high and might be reduced 25 per cent or more without difficulty, although the reduction is not safely to be accomplished by horizontal cutting. The Boston Edison Company was one of the organizations investigated, and in the four months' period covered by the investigation it paid $1 in compensation under the act for each $115.21 of wages, there being 1500 employees, 107 accidents and $9,000 insurance paid. The payroll was $490,227. The percentage of compensation paid for injuries during the four months to the insurance premiums paid was 47.2 per cent. For the total group of 25,803 employees investigated, figured on the payrolls, the average cost of workmen's compensation amounted to the sum of $1 for each $492.88 in wages.

Right Relation Between Capital and Labor

At the last meeting of the Electrical Manufacturers' Club Dr. Charles W. Eliot delivered an address on "The Fortunate or Happy Condition of a Life of Labor," which made a strong impression at the time and which the club has now published for distribution among its members. The following extracts from the address are made from an advance copy.

Dr. Eliot enumerates the conditions essential to happiness in labor as being the feeling of freedom to choose and change employment, the pleasure derived from exercise of bodily and mental powers, the joy of achievement, the hope of advancement, the element of risk or danger, and most important of all, "a loyal state of mind on the part of the workman."

"Employers and employed alike need to understand better than they do now the conditions under which satisfaction in daily toil becomes not only attainable but natural and inevitable, and to see clearly that the prime condition is loyalty on both sides.

"This club consists of employers on a large scale in a new industry made possible by comparatively recent discoveries in science, both pure and applied. I imagine your business to be as good a one as any in the country in which to work out and put in practice the best doctrines with regard to satisfactory conditions of work and to friendly and loyal relations between employers and employees. It seems to me that within the last fifteen years good progress has been made in developing both in employers and employees the right state of mind on these subjects. Employers have learned that it is 'good business' to make all the surroundings of their working people healthful and cheerful, to take thought for the housing of their workmen, to put their factories in such places that their permanent employees can live a family life in cottages with gardens, to make provision in the vicinity for public playgrounds and play buildings, so that wholesome recreations may be within easy reach, and to do everything possible to promote the safety, health and sensible pleasures and satisfactions of the workmen and their families.

"All this is not charity, but mutual service. If he is sufficiently independent or belongs to a trustworthy association of employers, [the intelligent employer] resists steadily all efforts to create monopolies in the kinds of labor he employs, and especially tries to carry on his works in a way to secure to his workmen the precious freedom to work zealously. He makes just provisions for dealing promptly with complaints, consults his employees beforehand concerning any changes in methods or rules which will affect them, and explains the benefits to both parties which he anticipates from the changes proposed. He is experimenting carefully on profit-sharing methods, the most promising mode of creating and maintaining satisfactory relations between employers and employed. He maintains a rising scale of wages based on efficiency and length of service, does his utmost to secure for his workmen steady employment, and takes care of employees who have passed their prime and need lighter jobs. In the interest of his workmen, as well as his own, he seeks assiduously steady, and hence broad, markets—world-wide are the best; so that no local depression can close his factory.

"He makes the discipline of his works contribute to train all newcomers to neatness, punctuality and fidelity. Fully realizing that the interests of his workmen are bound up with the life of his works, he labors to keep his industry profitable, and therefore a sure support for his employees as well as for himself, lays by an ample reserve of profits, charges off every year adequate amounts for deterioration, and in general keeps in mind the permanence and solidity of his business as the source of the livelihood of his hundreds or thousands of employees. If the establishment is old enough to have secured a firm reputation for success-

ful management, and therefore for durability, he establishes a pension system, thereby increasing efficiency in his works and also making promotion more rapid among the permanent workmen.

"He rejects the policy of the highest possible immediate profit, without regard to stability of the business in the future, as inconsistent with the right view of his trusteeship for his partners or shareholders and his employees alike, and believes that the only way to bring in the reign of industrial peace is to deal righteously and humanely with the people he employs, competes with, buys from or sells to."

New Arkansas Law on Theft of Electricity

Owing to the lack of a comprehensive statute dealing with the theft of electricity or tampering with electric meters, offenses of this kind have heretofore been quite prevalent in Arkansas, while punishment of the delinquents was under the former laws very difficult. The Arkansas State Legislature has just passed an act, worded as follows, imposing a fine of $100 or one year's imprisonment, or both, for electrical offenses of this kind:

"Whoever unlawfully and intentionally injures or destroys, or permits to be injured or destroyed, any meter, pipe, conduit, wire, line, pole, lamp or other apparatus belonging to any person, firm or corporation engaged in the manufacture or sale of electricity for light, heat, power or other purpose, or unlawfully and intentionally prevents an electric meter from duly registering the quantity of electricity supplied, or in any way interferes with its proper action or just registration, or without the consent of such person, firm or corporation unlawfully and intentionally diverts any electric current from any wire of such person, firm or corporation, or otherwise unlawfully and intentionally uses or causes to be used, without the consent of such person, firm or corporation, any electricity manufactured or distributed by such person, firm or corporation, shall be deemed guilty of a misdemeanor and shall for every such offense be punished by a fine not exceeding $100, or by imprisonment not exceeding one year, or by both fine and imprisonment."

Lighting Controversy at Webster Groves, Mo.

Several weeks ago bids for lighting the streets of Webster Groves, a suburb of St. Louis, were advertised for. It was stipulated in the specifications that 1 per cent of the gross receipts should be paid to the city in consideration of a franchise. Both the Electrical Construction & Maintenance Company and the Western Power & Light Company filed bids, but the Maintenance company offered to furnish light at $383 a year less than the Western company, so the contract was awarded to the former concern. Although Mr. Einstein, president of the Maintenance company, said that the 1 per cent clause was contained in the bid of his company, it was not mentioned specifically, so Mr. F. W. Mott, president of the Western company, petitioned the courts not to allow the city officials to contract with the Maintenance company. When the case was brought before Judge McElhinney of the Circuit Court, it was, however, dismissed.

Opinion on Refund of Excess Charges

In the case of the city of Louisville, Ky., versus the Cumberland Telephone & Telegraph Company, seeking to compel a refund of amounts collected by the telephone company during several years past in excess of ordinance rates which were upheld not long ago by the Supreme Court of the United States, Judge Walter Evans, in the United States court at Louisville, recently handed down two interesting opinions. In the petitions which A. Englehard & Sons and others of the Cumberland company's subscribers wished to enter supporting the city in its stand for a refund Judge Evans declared that such action could not be admitted until it is determined whether or not the present ordinance under which the Cumberland company is forced to operate is confiscatory. Overruling the protest of City Attorney Clayton B. Blakey, Judge Evans amplified the powers of Special Master Allie G. Ronald, who has been appointed to investigate the Cumberland company's collections and to determine the amount of the refund which is asked, and has complimented Special Master Ronald upon his work thus far.

Bill to Tax Utilities for City Revenue

Representative Isler, of Pittsburgh, has introduced before the Pennsylvania Legislature a bill to permit cities of the second class to tax all street-railway, telegraph, electric-light, power, water, gas and heating companies for general revenue purposes. The tax on street railways is fixed at 25 cents per linear foot of track; on telephone, telegraph and electric-light companies at 0.5 cent a foot for each linear foot of pole lines or wires laid and 5 cents a linear foot for conduits, and on water and gas companies at 3 cents for each linear foot of pipe laid.

Protest Against Higher Rates at Lexington, Ky.

To protest against the proposed increase in rates of the Fayette Home Telephone Company, of Lexington, Ky., and also against the proposed award of a franchise for the Lexington Utilities Company, to sell electricity at a slightly higher rate during the next twenty years, special committees of Lexington citizens have been appointed at mass meetings recently held. Strenuous opposition has developed to either of these steps on the part of Lexington public utilities, but it is believed that ultimately the stand of the Lexington Utilities Company for more liberal rates, in order to enable it to improve its plant, will be supported.

All Concerns Selling Energy Must Pay Tax as Utilities

Reversing the ruling made by former Attorney-General U. G. Denman, Attorney-General T. S. Hogan, his successor, has rendered an opinion to the State Tax Commission of Ohio to the effect that all companies, firms or individuals which sell energy, whether excess or from their regular business, should be classed as public utilities and pay the excise tax on their gross receipts. They are immune from the Willis tax under his ruling. Both Cleveland and Cincinnati have a large number of companies which sell energy to neighboring concerns but do not make this their main business. They will be compelled to pay the excise tax just as if they were engaged exclusively in selling energy. The tax commission has held this view all along and this is the reason why an opinion was asked the second time.

Public Utility Measures Before Illinois Assembly

Representative Hollenbeck has introduced into the Illinois Legislature House bill No. 186, providing for speciai taxation up to the legal limit for payment of bonds on electric-light plants, street-railway systems and other utilities where a city or village is about to forfeit such improvements through inability to meet payments due. Repre-

sentative Rinehart has introduced House bill No. 201, which requires a public hearing and advertisement before the confirmation of public-utility franchises. Senator Harris has introduced Senate bill No. 236, one of the Chicago charter measures, which is a public-utilities bill for the city of Chicago.

Public Service Commission News

Ohio Commission

The Public Service Commission of Ohio has authorized the Hocking Power Company to issue to the John A. Stewart Electric Company $60,000 worth of stock for the purchase of the Stewart company's business and property by the Hocking company. The purchaser asked permission to issue in all $90,000 in return for the Stewart property, but the commission has limited to $60,000 the amount allowed.

The Public Service Commission has also granted the Buckeye Light & Power Company authority to issue $8,500 worth of additional capital stock. Of this amount, $5,500 is to be expended on improvements to the company's generating plant and $3,000 for the building of a transmission line to Ludlow Falls, Ohio.

California Commission

The United Light, Fuel & Power Company, operating in San Diego, Coronado and vicinity, has applied to the commission for authority to issue $100,000 of capital stock to pay indebtedness for construction work and improvements.

Complaint has been filed by citizens of Jamestown asking that the Railroad Commission regulate the rates and service of the Tuolumne County Electric Power & Light Company.

The Pacific Gas & Electric Company has applied for permission to devote a portion of the proceeds received from the sale of its last issue of $5,000,000 of bonds to the enlargement of the Bear River Canal. This canal will carry water from Lake Spaulding reservoir, making it available for irrigation purposes in Placer County.

The Great Western Power Company has applied for a certificate of public convenience and necessity to serve Yuba County and the city of Marysville with electricity.

New York Commission

The New York Public Service Commission, Second District, has authorized the Deer River Power Company of Watertown, to issue $45,000 of 6 per cent bonds, the proceeds to be used in discharging liabilities incurred for capital purposes.

The Second District commission has given to the Schenevus Electric Light & Power Company its permission to transfer to the Great Bear Light & Power Company all its property and franchises. The latter is authorized to construct a transmission line from its Worcester plant to the lines of the Schenevus company and to furnish electricity at Maryland in Otsego County.

Wisconsin Commission

The Wisconsin Railway, Light & Power Company, of Milwaukee, has been authorized to issue $1,229,000 of capital stock and $2,225,000 of 5 per cent first mortgage refunding gold bonds. These securities are to be issued for the purpose of acquiring the following: All property and assets formerly belonging to the La Crosse Water Power Company and sold at a foreclosure sale on Oct. 11, 1912; all of the outstanding $365,000 of common stock, $67,500 of preferred stock and $483,000 of bonds of the Winona Railway & Lighting Company and the $302,200 par value of capital stock of the La Crosse City Railway Company.

Massachusetts Commission

The Massachusetts Railroad Commission gave a public hearing last week on the service conditions of the Worcester Consolidated Street Railway, which was of unusual interest in view of the discussion it brought out concerning the larger power problems of Worcester County transportation. The city had appealed to the board to order service improvements, filing reports on conditions of traffic and energy supply at Worcester during the past month. President Dewey of the Consolidated company and President Henry I. Harriman of the Connecticut River Transmission Company outlined the work now under way to improve the power supply of the system. At present energy is furnished by a 5600-kw turbine station at Millbury, Mass., a 3450-kw engine-driven plant of old design at Worcester and the Connecticut River system through a 600-kw substation north of the city. Contracts have been let for the installation of an additional 5000-kw turbo unit at Millbury and for the purchase of 7000 kw from the interconnected system of the Connecticut River and New England Power companies through a switching station to be built at Millbury. President Harriman stated that inside of two months it would be possible to supply the company with 2000 kw at Millbury, and that when the new 100-mile line is completed between the Shelburne Falls district and Millbury the transmission system would have 10,000 kw of primary power and 6000 kw of secondary power available for the service. President Dewey of the railway company spoke briefly, contending that the utmost effort is being made to increase the power supply and strengthen the service in Worcester.

Current News Notes

North St. Louis Business Men to Visit Keokuk.—As the guests of the Union Electric Light & Power Company of St. Louis and the Mississippi River Power Company of Keokuk, Ia., a party of North St. Louis business men will visit the great water-power plant under construction at Keokuk on March 26. Special trains have been chartered.

* * *

Damage to Black River Falls Dam.—During the high water of March 14, 1913, three of the Tainter gates in the dam of the hydroelectric development at Black River Falls, Wis., were destroyed by ice. The accident is said to have been due primarily to the breaking of a gear hoist when the attempt was made to lift the gates. After the ice went out the river fell rapidly but at the crest of the flood there was 8 ft. of water going over the gates. No damage was done to the concrete work or the power house. Black River Falls was the scene of a disastrous flood in October, 1911, when much damage was done to the property of the La Crosse Water Power Company.

* * *

Incendiarism in New York City.—In his report on incendiarism in New York City, submitted to Mayor Gaynor, Mr. Joseph Johnson, fire commissioner, declares that the crime of arson is responsible for one-fourth of New York's annual fire losses and involves the destruction of $4,000,000 worth of property each year. The commissioner's report is a 160-page volume containing interesting accounts of many cases of incendiarism, together with pictures of fires, "plants," portraits of firebugs, etc. Lax methods followed by the fire insurance companies in granting policies are largely blamed for the appalling growth of professional arson. It is shown, for example, that on property worth only $3.96 it was actually possible to obtain $127,500 worth of insurance in the form of 135 different policies. Many trades profit from incendiarism. The report, which was prepared by Mr. W. B. Northrop, temporary inspector in the Metropolitan Bureau of Fire Prevention, recommends that rigid investigation be made into the character of all applicants for fire insurance and that the property be inspected carefully. Appendices to the report outline the methods followed by German and other European fire insurance companies in making property examinations.

SEWER DISCHARGE TO BE UTILIZED FOR POWER GENERATION.—It is reported that Mayor Laughlin of Niagara Falls, N. Y., is behind a scheme to develop hydroelectric power from the outflow of the city's trunk sewers. These sewers now empty into the lower Niagara River, and the Mayor is said to believe that the energy going to waste is sufficient to light the city.

* * *

UP-TO-DATE BURGLARS.—According to the police, burglars who blew open a safe in the office of a small theater in Chicago recently used modern methods. It is surmised that the thieves bored a hole in the safe near the combination lock by the use of a high-power electric drill. This hole was filled with an explosive and plugged up with a cartridge. It is believed that electricity was also used to fire the cartridge.

* * *

FIRST AID TELEPHONE SERVICE.—A plan proposed in Chicago may make it possible to secure quick emergency attention in case of injury, by the co-operation of the Chicago Telephone Company and the police department. It is proposed that in case of accident, or where immediate medical attention is needed, any person may call up "Main 13," the police call. Connection will at once be made with the nearest police station by the telephone company, and the desk sergeant in turn will send the nearest physician on the first-aid list in his possession to the address given. In case of serious accident this first-aid emergency service through the nearest telephone might prove of great value.

* * *

BRITISH ELECTRICAL MANUFACTURERS' ASSOCIATION.—At the annual dinner of the British Electrical and Allied Manufacturers' Association, held recently at the Savoy Hotel, London, Lord Ampthill presided, and was supported by Lord Suffield, Mr. Bruce Anderson, chairman of the association; Mr. W. Duddell, president of the Institution of Electrical Engineers; Mr. Samuel Insull, president of the Commonwealth Edison Company of Chicago; Sir Alexander Kennedy, Mr. Worthington Evans and Sir Laurence Gomme. In proposing a toast to the association, Mr. Insull urged the need of greater co-operation between the manufacturers of electrical apparatus and the producers of central-station energy. The toast of "Kindred Institutions and Our Guests" was proposed by Mr. S. Z. de Ferranti and responded to by Mr. W. Duddell and Colonel Sir N. J. Moore.

* * *

PROPOSED PERMANENT QUARTERS OF ELECTRIC CLUB OF CHICAGO.—A subject of much interest to the members of the Electric Club of Chicago is the proposal to establish permanent quarters. The committee appointed the week before on this subject by President Keech reported at the meeting of the club. It consisted of Messrs. J. H. Goehst, F. W. Harvey, H. A. Mott, H. E. Niesz, N. F. Obright, C. G. Sharpe and F. P. Vose, representing the general membership of the club and not any member of the administration. This committee said that the project of obtaining the fifth and sixth floors of the old Hamilton Club Building on the corner of South Clark Street and West Monroe Street was feasible and practicable. The rental would be $4,000 for the first year and $4,800 for the three succeeding years. It is proposed to have the usual club comforts, including the serving of meals, billiard and pool tables, a reading room, etc. The committee recommended that the membership be inreased to 500 and the dues be raised from the present rate of $5 a year to $12 a year, with an initiation fee of $10 instead of $5, as at present. There was an extended discussion on the subject, some of the members being reluctant to abandon the plan for a simple luncheon club, which has been quite successful. It was finally decided to print the report of the committee and send it to all the members, asking them at the same time to express their views on the subject of enlarging the club's scope of operation and increasing the dues.

* * *

ONE THOUSAND FIVE HUNDRED AND SEVENTY-FOUR INVENTORS SEEK TRAIN-STOP PRIZE OF $10,000.—In reply to the offer of President Charles S. Mellen of the New York, New Haven & Hartford Railroad to award a prize of $10,000 for a successful automatic train-stop which will prevent engineers running by danger signals, 1574 applications have been received. Hardly 5 per cent of the number obtained are, however, worthy of consideration, according to the engineers for the road. Two devices which are regarded as practical will be tested at once. Several startling schemes were proposed. One inventor's device was guaranteed to work with entire safety to the passengers but "would probably kill the engineer and fireman." Another invention provided for a spring hook to rise in the track and firmly grasp the axle of the locomotive. Applications were sent in from all over the world—Panama, Porto Rico, Jamaica, Belgium, France, Ireland, Hawaiian Islands, England, Scotland, Wales, Germany and Denmark are among the countries represented. The competitors represent nearly every walk of life, from clergymen to jailbirds. Four of the inventors are now in jail, and four are in insane asylums. One has been indicted in Canada for attempting to sell stock in his train-stop company.

* * *

COMMONWEALTH EDISON SERVICE.—At a recent meeting of the Commonwealth Edison Company Section of the National Electric Light Association in Chicago, Mr. Peter Junkersfeld, assistant to the second vice-president, gave an interesting talk, illustrated by lantern-slide diagrams, on "Commonwealth Edison Service." He said that of the 450,000 houses and apartments in Chicago, 104,800 use electric service. The company has about 2000 stockholders, and of these about 300 are employees. The total number of employees is 3770. Of their number 2000 are depositors in the savings fund by means of which they may eventually become stockholders. One interesting chart gave the proportion of employees engaged in the actual production, transmission and distribution of electricity, as compared with the number engaged in the other departments which are necessary for modern central-station service. It was shown that the first group is very much smaller than the second. Referring to the company's railway load, Mr. Junkersfeld said that roughly about 70 per cent of the kilowatt-hours consumed for railway transportation in the city of Chicago is furnished by the Commonwealth Edison Company. The entertainment features consisted of selections by the banjo club and a fencing contest.

* * *

SOCIETY MEETINGS

NEW YORK JOVIANS.—Mr. John W. Lieb, Jr., vice-president and general manager of the New York Edison Company, addressed the luncheon meeting of the Sons of Jove, New York, March 19, on the subject of "Rates."

* * *

DETROIT INDUSTRIAL ELECTRICAL SOCIETY.—At a meeting of the Industrial Electrical Engineering Society, Detroit, Mich., March 13, Dr. Edwin S. Sherrill gave a practical demonstration of the pulmotor loaned for the occasion by the Detroit Edison Company.

* * *

MEETING OF THE ELECTRIC VEHICLE ASSOCIATION.—On Tuesday, March 25, at 8 p. m., the regular monthly meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building, New York. Mr. H. F. Thomson, of the Massachusetts Institute of Technology, will present a paper on "Observations on Horse and Motor Trucking."

Lynn Section, A. I. E. E.—At the meeting of the Lynn (Mass.) Section, A. I. E. E., March 12, the subject of street lighting by means of arc lamps was discussed by Messrs. G. N. Chamberlain, C. A. B. Halvorson and Lyman Arnold, of the General Electric Company's Lynn works.

* * *

Washington University Branch, A. I. E. E.—Mr. H. F. Thomson, research assistant at the Massachusetts Institute of Technology, Boston, addressed the meeting of the Washington University Branch, A. I. E. E., March 10, on the subject of "Costs of Trucking by Horse, Gasoline and Electrical Power."

* * *

New York Street Lighting.—At a meeting of the New York Electrical Society to be held in the Engineering Societies Building on March 28 Mr. C. S. Lacombe, chief engineer of the Department of Water Supply, Gas and Electricity of New York City, will lecture on street lighting and fixtures of New York City.

* * *

Missouri Convention in Kansas City.—The annual convention of the Missouri Electric, Gas, Street Railway and Waterworks Association will be held in the Baltimore Hotel, Kansas City, Mo., on April 17, 18 and 19. Mr. P. A. Bertrand, of Jefferson City, is president of the association, and Mr. Percy W. Markham, of Brookfield, is secretary and treasurer.

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New York Section, N. E. L. A.—At the first "ladies' night" meeting of the New York Companies' Section, N. E. L. A., March 17, Mr. Raymond Ditmars, of the New York Zoological Gardens, gave an illustrated lecture concerning "Reptiles" and his experiences in capturing most of the specimens in the Bronx Park collection. The speaker exhibited a number of live snakes and explained how to avoid danger in handling poisonous reptiles. Nearly 400 persons were present.

* * *

Cosmopolitan Company Section, N. E. L. A.—The Cosmopolitan Electric Company Section, N. E. L. A., held an interesting educational meeting on March 13, when, with Mr. Ira Hampton as temporary chairman, the "Story of a Kilowatt" was detailed, from the cial pile to the consumer, by the various employees of the company in daily contact with each department. Mr. H. E. Wulfing acted as interlocutor. Messrs. H. E. Niesz, manager, and Mr. A. H. Sweetnam, electrical engineer, also spoke briefly during the evening. At the meeting in April Mr. F. P. Vose, past-chairman of the Electric Club of Chicago, will give an illustrated lecture on the Panama Canal.

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Pittsburgh Section, A. I. E. E.—"Standardization" was the subject of discussion at the meeting of the Pittsburgh Section, A. I. E. E., March 11, when several papers read at the recent New York midwinter convention were abstracted. The topic of ratings provoked an especially lively discussion. Among those who took part in the meeting were Messrs. B. G. Lamme, Charles Robbins, C. Fortescue, E. M. Olin, S. W. Farnsworth, L. W. Chubb, P. M. Lincoln, J. W. Welsh, R. W. Atkinson, J. S. Jenks and E. L. Farrar. Mr. F. D. Newbury presided in the absence of Vice-chairman A. M. Dudley. Arrangements are about completed for the Institute meeting at Pittsburgh on April 18 and 19, under the auspices of the committee on electricity in mines.

* * *

Joint Illumination Meeting at Boston.—At a joint meeting of the New England Section of the Illuminating Engineering Society and the New England Section of the National Commercial Gas Association at Boston on March 12 President Preston S. Millar of the Illuminating Engineering Society presented a paper and demonstration illustrating various phases of modern lighting practice. The three model rooms with miniature furnishings and fixtures, formerly shown in New York, were used to exhibit a large variety of combinations. A brief discussion followed the demonstration, the participants being Messrs. Sidney M. Bewley, C. E. Ware, Jr., J. W. Cowles, R. B. Hussey and C. E. Mason. The point was made that complaints of poor lighting often arise from the use of improper glassware or fittings or from insistence upon the use of bare lamps.

* * *

Railway Signal Association.—The stated meeting of the Railway Signal Association in Chicago on March 17 drew the largest attendance at any convention of the association in the last six years. Mr. B. H. Mann, signal engineer of the Missouri Pacific Railroad, presided. The committees on "power interlocking" and "manual block" made reports. The outcome of the first committee's report was the drafting of specifications for minor accessories in interlocking towers. The "manual block" committee favored displacing hand signaling at interlocking plants with caution cards stating that the block was out of order. The specifications submitted for alternating-current signaling on steam roads were adopted. A report was submitted on the progress made toward formulating specifications for storage batteries, and more time was requested for completing this work. Reports on standard designs, on specifications for wire and cable and on methods of recording signal performances were made by the respective committees.

* * *

Chicago Jovian Lunch Club.—Mr. George W. Elliott, of New York, advertising manager of the *Electrical World*, addressed the Chicago Jovian Lunch Club on March 17. He spoke of the work of the Society for Electrical Development and said that this organization, like Jovianism, exemplified the spirit of co-operation—the bringing together of all branches of electrical work. Mr. Elliott commented on the fact that similar work is being undertaken in Great Britain. He claimed that the great national movement, to be effective, must be backed by local work and local enthusiasm. Every man must "boost the other fellow's game." Mr. George C. Richards, statesman for Illinois, presided at the meeting. On motion of Mr. J. H. Delany, former statesman, it was voted to request the Society for Electrical Development, as far as practicable, to handle its work in Chicago through the local branch of the Jovian Order. Mr. H. E. Niesz moved that a committee be appointed to cooperate with other electrical organizations in Chicago, notably the Electric Club, in the matter of securing permanent quarters for the various electrical societies.

* * *

Los Angeles Section, A. I. E. E.—The deferred February meeting of the Los Angeles Section of the A. I. E. E. was held on March 4 at the Hollenbeck Hotel. No original paper was presented at this time but several written discussions of certain of the papers presented in New York at the midwinter convention were read. Mr. A. W. Harris read and discussed the paper entitled "Rating of Oil Circuit-Breakers with Reference to Rupturing Capacities," by Mr. G. A. Burnham. Mr. E. Woodbury discussed Mr. Paul Dushman's paper, "The Heating of Cables Carrying Current," and described certain tests and calculations on high-voltage cable. Mr. E. R. Northmore spoke briefly upon painting underground cables black to raise the safe carrying capacity. The paper "The Temperature Rise of Stationary Induction Apparatus as Influenced by the Effects of Temperature, Barometric Pressure and Humidity of the Cooling Medium," by Messrs. J. J. Frank and W. O. Dwyer, was discussed by Prof. R. W. Sorenson of Throop Unisity. Professor Sorenson described the conditions under which the test data were obtained. Chairman George A. Damon announced that the members of the section will be the guests of the Southern California Edison Company at Long Beach in the near future.

Mount Hood Hydroelectric Developments—I

Hydraulic features of the system for generating 60,000 hp from glacial streams and transmitting it to Portland, Ore. By W. P. Brereton and R. H. Mulock

PORTLAND, ORE., is a city of about 225,000 population and, on account of its advantageous geographical position, is destined to be one of the most important centers on the Pacific Coast. Although the Portland market has been served by the Portland Railway, Light & Power Company, which has from time to time added to its equipment in an endeavor to meet the increased demand, the market was sufficiently inviting for the Mount Hood Railway & Power Company to enter the field.

The Mount Hood Railway & Power Company was formed in 1906 and at that time secured land and water rights on the Big Sandy, Little Sandy and Bull Run Rivers. Surveys were made and a scheme was worked out for the generation of electricity which would, when completely developed, deliver 60,000 hp to Portland. Some work was done during 1906-07, particularly on the grading of the railroad and the excavation for the generating station, penstocks, etc., and contracts for two turbines were awarded to the Platt Iron Works. From 1907 to the fall of 1910 enough work was performed to hold the rights obtained.

In the fall of 1910 work was recommenced and it has since been energetically prosecuted. Franchises were secured in Portland and surrounding towns giving the company the right to sell energy for heating, lighting and industrial purposes and to construct and maintain transmission and distribution systems on the streets. Franchises were also secured from the counties of Multnomah and Clackamas, giving the company rights to construct and maintain transmission systems along certain roads. The railroad was rushed to completion as quickly as possible to allow delivery of construction materials and equipment.

HYDRAULIC DEVELOPMENT

The hydraulic development, as originally proposed, consisted of three distinct schemes, a high-head development, an intermediate-head development and a low-head development. The intermediate-head development only is at present constructed, but short descriptions of the other two developments are here given.

The drainage areas are those lying west and south of Mount Hood, these being drained by the Big Sandy, Little Sandy and Bull Run Rivers and their tributaries. Because the rivers above mentioned are all similar in the rate of fall, the three schemes were naturally very similar in general features. The water was in each case to be diverted from the river channel into a flume or canal, the difference in fall of the river and flume accounting for the available head.

Near the junction of the Big Sandy and Bull Run Rivers is located a naturally advantageous reservoir site, there being a bench of approximately 300 acres area which is in general 325 ft. in elevation above the Bull Run River. This is the site of the reservoir for the intermediate-head development. Immediately adjoining this bench is the terminus of the watershed between the Big Sandy and Little Sandy Rivers, and on top of this is located a site for a much smaller reservoir at an elevation of about 650 ft. above the Bull Run River. This was to be the site of the reservoir for the high-head development.

The high-head aqueduct was to be built along the Big Sandy side of the watershed for a distance of approximately 10 miles to a location just above the junction of the Salmon and Big Sandy Rivers where water from both would be diverted into it.

The intermediate-head aqueduct is built on the Bull Run and Little Sandy River side of the watershed for a distance of about 17,000 ft. to a point where the diversion dam is located on the latter river. Just above this dam water is delivered from the Big Sandy River by means of an aqueduct in a tunnel through the above-mentioned

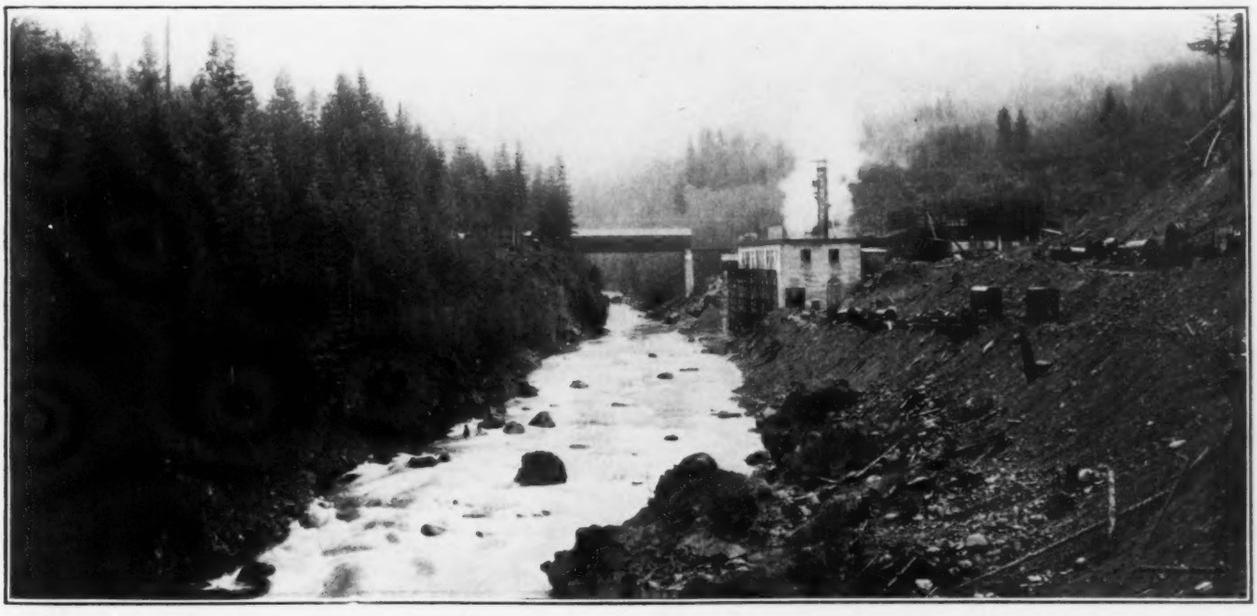


FIG. 1—VIEW OF GENERATING AND TRANSFORMER STATIONS ON BULL RUN RIVER

watershed. The intermediate-head development is, therefore, supplied from both the Big and the Little Sandy River. A large storage reservoir on the Salmon River was to be formed to regulate the water supply for these two developments.

One power house was to be used for the intermediate and high-head developments, the water from which, as well

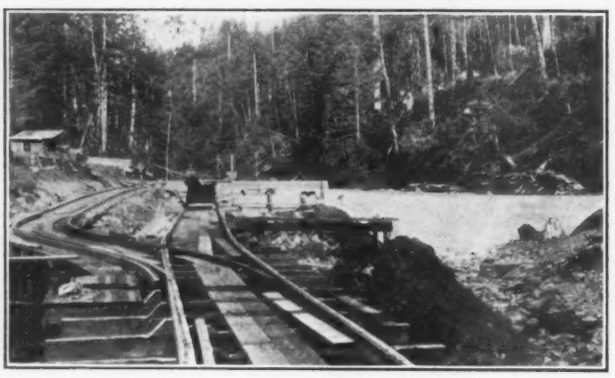


FIG. 2—INSPECTION CAR AT BEGINNING OF FLUME

as from the Bull Run River at this point, was to be carried in an aqueduct for a distance of about 7 miles to a reservoir which was to provide a head of 245 ft. above the Sandy River. A branch feeder for this aqueduct was to carry a supply from the Big Sandy River from a point a short distance from its junction with the Bull Run River. This formed the low-head development.

The area drained by the Big Sandy River for the intermediate head is approximately 225 sq. miles, and that drained by the Little Sandy River 28 sq. miles. The precipitation over these areas varies with the elevation, the mean at 700 ft. and 3600 ft. above the sea level being respectively 71.6 and 82.5 in. annually for a period of twenty years. As the mean elevation of these two watersheds is 4800 ft., the probable mean rainfall is 87 in. August, September and October of each year are very dry months, but the nature of the formation is such that the precipitation in the rainy season percolates into and is stored in the porous volcanic rocks, soils and glacial and other gravelly layers, to be discharged slowly and somewhat regularly during the dry seasons. Thus the rivers have a general supply from this source. The Big Sandy River is also sup-

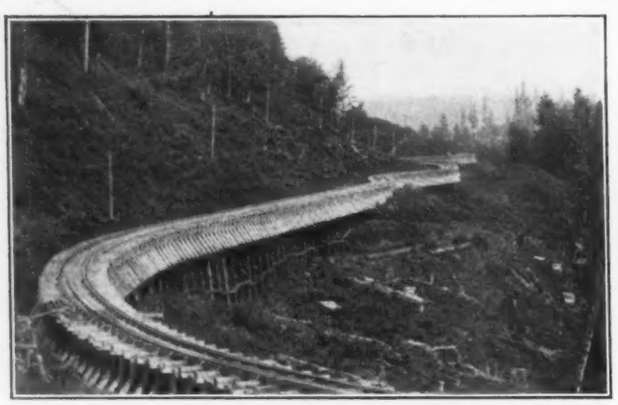


FIG. 3—FLUME ALONG THE MOUNTAINSIDE

plied from the melting glaciers on the west slopes of Mount Hood. The intermediate-head development has been practically completed.

Little Sandy Dam

The Little Sandy dam is composed of solid concrete resting on basaltic rock of comparatively dense formation. No borings were made to investigate the underlying formation, as the head above the riverbed (rock) does not exceed 12 ft. In relation to the direction of the river the dam is located diagonally, increasing the length of the spillway so as to limit the rise of head during high water to 2½ ft. A portion of the spillway, that located in the center of the watercourse, is depressed 3 ft. to act as a sluiceway for debris during high water. This portion is provided with stop logs to be used during the dry season if required. The intake is situated at the extreme northerly end and is provided with wooden racks and stop logs. An additional short spillway is provided behind the stop log location, as the water is gradually accelerated to the velocity required in the flume.

Little Sandy Flume

The Little Sandy flume is built entirely of wood, Douglas fir being used exclusively with the exception of the footings, which are of cedar. Just below the diversion dam, the flume crosses the river on a Howe truss bridge, supported on rock-filled cribs, to the south side of the canyon. This mountainside is very steep and irregular, the flume being carried on bents in places, while in others rock or earth was excavated, allowing the caps on which the stringers rest to lie direct on the mudsills.

In general a bearing pressure of 1½ tons to the square foot was allowed for footings. The floor and sides are of 2-in. planks, leakage between planks being prevented by the use of ½-in. by ¾-in. splines in properly formed

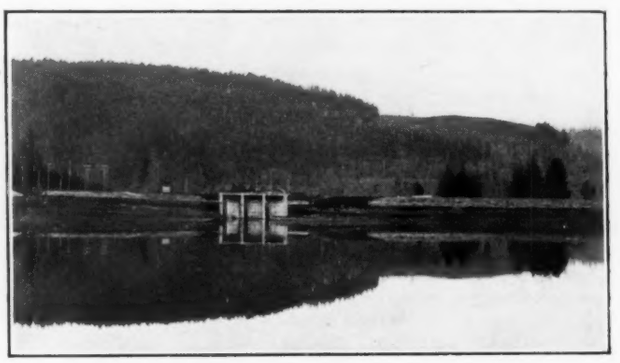


FIG. 4—RESERVOIR AND PENSTOCK OPENINGS

grooves. The flume has a fall of 2 ft. in 1000 ft. and is designed to carry 800 cu. ft. of water per second. Posts and mudsills were cut along the line of the flume. All dimension timber, however, had to be delivered from the lower end, and as the country was so rough as to eliminate almost the possibility of road construction for this purpose, a standard-gage service track was built on the floor of the flume and gasoline motor cars with trailers were used with very satisfactory results.

Reservoir

The reservoir is formed by the construction for about two-thirds of its periphery of an earthen embankment which varies in height to a maximum of 45 ft., while for the remainder the natural elevation of the land serves to confine the water. Very great care was taken in the construction of this embankment, the material for which, taken from the reservoir site, consisted of red clay with not more than 5 per cent of gravel at any location mixed with it. The material was hauled to the embankment in wagons, deposited in layers of not more than 12 in., harrowed and rolled. During the dry season sprinkling was resorted to in order to assist in the packing. All vegetable matter in the foundation had first been removed. The water face of all built embankment was riprapped and a considerable area at the discharge of the flume was also riprapped.

Considering the area of the reservoir in comparison with the maximum quantity of water available from the flume, it was deemed unnecessary to provide a spillway, as ample

time would elapse for the placing of stop logs at the intake to the flume before the water would reach a dangerous elevation.

The area of the reservoir at a level of 5 ft. below the top of the embankment is 160 acres and its total capacity is 2103 acre-ft., sufficient in case of any total interruption in the water supply to develop the full capacity of five tur-

FIG 5—PENSTOCKS AND SURGE TANKS

bines for thirty-six hours with a load-factor of 60 per cent. It is so large that it need not here be considered in relation to the daily peak load but should be studied in connection with the dry periods.

The maximum and minimum monthly consumption of electric energy in Portland occur during December and April respectively. There is, however, an abundance of water available during both months. During September the demand for energy is little in excess of that in April and about 80 per cent of the demand in December, but the water supply is limited. Considering that during December the demand is sufficient to load five machines, using 60 per cent as the ratio of the average load during the month to the maximum hourly load for the month, there would be required approximately 660 cu. ft. of water per second, and 660 divided by 0.8 gives 528 cu. ft. of water per second required during September, as the same load-factor obtains. Assuming 1910 as an average year, there is available only 365 cu. ft. of water per second, and by allowing the water in the reservoir to be lowered 30 ft., 91 cu. ft. of water per second would be available from that source. The rest of the energy must, however, be obtained from an auxiliary steam plant. During the month of August of an average year the steam plant will also be required to deliver energy, but during the other months the supply of water is sufficient with the aid of the storage to develop enough energy to meet the demand.

PENSTOCKS AND INTAKE

Provision is made for three complete penstocks, although two only are at present constructed. The intake is completed in every respect for three. It is built of reinforced concrete provided with one 10-ft. diameter butterfly (motor-operated with hand auxiliary) valve for each penstock, wooden racks and provision for stop logs. The head end of each penstock is anchored in the concrete intake.

Each penstock is 9 ft. in diameter and placed at such an elevation that it will practically drain all the water from the reservoir. This necessitated the placing of the upper portions in tunnels driven under the earthen embankment to the face of the bluff. There is built in place only 160 linear ft. of the third penstock, sufficient to carry it well beyond the earthen embankment. Great care was exercised to prevent leakage around the intake through the tunnels, by means of cut-off walls, by concreting the upper ends of the tunnels and by clay puddles at the intersection of tunnels with the face of excavation.

From the face of the bluff the penstocks are laid in trenches along a bench at points near the edge of which they dip sharply into a second pair of tunnels, through which they pass to the power house. All penstocks in tunnels are surrounded by a very lean mixture of concrete which completely fills the space around the pipes. Concrete anchor blocks are provided in the trenches. Immediately above the power house each penstock branches into two pipes 72 in. in diameter.

Although each turbine is provided with a synchronously operated relief valve, it was thought advisable to neglect them in designing the penstocks. Each pipe is, therefore, designed to withstand an impact caused by the closing of the turbine gates in three seconds. The gates are designed to remain one-third open in case they become disconnected from the servometer of the governor. At the lower end of each 72-in. branch is located a 16-in. branch in which is placed a bursting plate to break at 250 lb. pressure per square inch. Special care was taken and experiments were performed to secure reliable results with these bursting plates. A dozen plates were cast from the same ladle. They were designed to fail in shear, a groove being cut in each on a diameter slightly less than that of the pipe. By trial and error, the proper thickness of metal at the bottom of the groove was determined. Each result was carefully checked against others for uniformity of material.

At a point on each penstock immediately below the lower ends of the upper tunnels is located a surge tank having a capacity sufficient to supply the needs of two machines for a period of five seconds.

POWER HOUSE

This is of solid reinforced-concrete construction with steel roof trusses and one temporary cement plastered end to allow for extension. It is at present built of sufficient length to accommodate four main units and two turbine-driven exciters. The generator room is 150 ft. long by 44 ft. wide; the height from generator room to bottom of roof

FIG. 6—COMPLETED GENERATING AND TRANSFORMER STATIONS ON BULL RUN RIVER

trusses is 39 ft. and the height of crane rail above main floor is 31 ft. The span of the crane is 44 ft. A service railroad switch is built into the power house just far enough to receive one standard car.

In a subsequent issue a description of the electrical features of the generating station on Bull Run River and of the transmission system to Portland, Ore., will be published.

The Purkinje Effect and Comparison of Flicker and Equality-of-Brightness Photometers

By M. Luckiesh

With the increasing diversity of types of light sources the demand for a means of comparing lights of different color is constantly growing. Recent investigations in heterochromatic photometry indicate the flicker photometer as the best means for such work, although there is not a complete agreement on some of the phenomena encountered when comparing lights of different color. Dow[1] found the Purkinje effect to be less with the flicker method than with the equality-of-brightness method, while Ives[2] found a reversed Purkinje effect with the former method. Miller[3] in photometering a mercury arc against incandescent lamps reported that the former measured much brighter at lower illuminations than would be indicated if the inverse square law rigidly held. With the flicker method this effect was absent. In connection with investigations being conducted by the writer at the Physical Laboratory of the National Electric Lamp Association, Cleveland, Ohio, it seemed of interest to test this point with a commercial flicker photometer at hand and at the same time make comparisons with an equality-of-brightness photometer both with contrast and without. At the same time it was desirable to compare the sensibilities of the three methods. For this purpose a Marten's flicker photometer was chosen. A simple photometer fitted with contrast screens was chosen for the direct comparison of brightnesses. Both instruments were made by Messrs. Schmidt and Haensch. The sources of light were tungsten lamps, and a red screen and a bluish green screen were placed one on each side of the photometer.

Two observers carried out parallel sets of observations throughout, the ordinary precautions being taken against prejudiced settings. The two observers checked identically with all three methods when balancing lights of the same color.

The results are plotted on a scale of illumination which was calculated on the assumption that the red light obeyed the inverse-square law. This, of course, is not true, but no better method presented itself and the effect is merely either to elongate or to telescope the scale somewhat at the low values of illumination. The values of illumination are those on the photometer screen calculated from the value obtained at a high illumination when the red light was balanced against that from a standard tungsten lamp by means of a flicker photometer. The actual illumination on the eye was of less importance because commercial photometers were used without alteration, making it easy to reproduce the same conditions in practice. The field size, which is of vast importance in heterochromatic photometry, was practically the same in both photometers—about 10 deg. The field in the Marten's flicker photometer consists of an inner circle surrounded by a circular ring, while the shape of the field in the equality-of-brightness photometer was a circle divided vertically. The contrast screens covered the upper and lower halves of the semicircles respectively.

The ratio of the square of the distance of the "red" lamp from the flicker photometer screen to the square of the distance of the "green" lamp is plotted as ordinates in the two upper curves in Fig. 1, for the two observers. It is significant to note that the two observers checked identically when there was no color difference. Observer K for a wide range of illuminations obtained a value for the ratio R/G about 13 per cent higher than observer L even with the flicker photometer. A pronounced reversed Purkinje effect was found for illuminations of the screen less than 1 meter-candle. The lamp and screens were reversed to eliminate any instrumental errors. The values obtained after reversal are indicated by the crosses, which show a close check. The same ratio calculated from the writer's data obtained with the equality-of-brightness photometer is plotted in the lower curve. The circles represent values obtained with a contrast field, while the dots represent the values obtained without contrast. It will be noted that there is a large difference between the values of the ratio R/G,

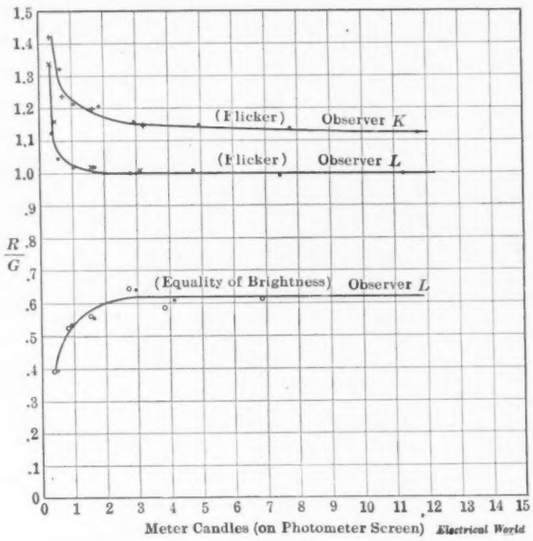


FIG. 1—PURKINJE EFFECT AND REVERSED PURKINJE EFFECT OBTAINED BY THE EQUALITY-OF-BRIGHTNESS AND FLICKER METHODS RESPECTIVELY

obtained by observer L by the two methods. The values obtained by the equality-of-brightness method (which were practically the same with a contrast photometric field as without contrast) were, for a wide range of illuminations, only 62 per cent of the values obtained with the flicker photometer. This difference illustrates that although the flicker photometer offers a means of eliminating the disturbing influence of color difference it does not measure the same quantity as measured by the equality-of-brightness photometer. The researches of Ives[4] show, however, that the flicker photometer which he used (a modification of the Whitman disk) is more desirable than the direct-comparison photometer.

The equality-of-brightness observations by observer K on being plotted were found to be quite scattered but indicated a real Purkinje effect. This observer was quite inexperienced in the photometry of lights of extreme color difference, while observer L has had considerable experience. The latter's data presented here check with data previously obtained by him and presented by Ives in his extensive research in heterochromatic photometry. The difference in the flicker measurements by the two observers was first thought to be due to a different criterion in each case. That is, it was found that slightly different results were obtained with the flicker photometer used if flicker was made to disappear in the central field or in the surrounding peripheral ring. This was found to be so slight, however, that in no way could it account for the 13 per cent difference. The flicker on the outer ring was disturbing and tended to cause difficulty in fixation of the eye on the central part of the field.

The sensibility of the three methods was next determined. The average deviation from the mean was computed for the various points of observation. These are sufficiently regular or consistent for the flicker method to bear plotting and are therefore shown in Fig. 2. At an illumination of 10 meter-candles on the photometer field the average deviation from the mean found by the writer was about 0.5 per

[1] J. S. Dow, *Phil. Mag.*, January, 1910; page 58.
[2] H. E. Ives, *Phil. Mag.*, July, 1912; page 149
[3] P. S. Millar, *Trans.* Ill. Eng. Soc., November, 1909; page 179.
[4] H. E. Ives, *Phil. Mag.*, 1912.

cent. This rose to about 0.9 per cent for observer K. However, it is a point highly in favor of the flicker photometer that a comparison of a red light with a blue-green one can be made with such small average deviation from the mean of a number of settings.

In the photometry of lights of different color by the equality-of-brightness method the writer has always favored a two-part field without contrast, but had previously made no determinations of the sensibility of the two methods. In the comparison of lights of such extreme color difference as those used in this investigation there was no consistent change of sensibility with illumination so that it seems legitimate to average the sensibilities computed at the various illuminations used. The average of the mean deviation from the mean of a large number of settings at each illumination was found for observer L to be 1.9 per cent and 1.6 per cent for photometric fields with and without contrast respectively. For observer K the sensibility was found to be 2.9 per cent and 3.3 per cent respectively, apparently being in favor of the field with contrast. But owing to the inexperience of observer K little weight can be given to this result. When there was no color difference the flicker method of 15 meter-candles gave results for observer L which sometimes indicated a sensibility as high as 0.2 per cent. Of course, under the condition of no color difference there is no reason to use the flicker photometer because a sufficiently high sensibility can be obtained with the equality-of-brightness method.

Comparison of the red and blue-green lights on various days checked very closely by means of the flicker method. Fairly close checks were made by the experienced observer from day to day with the equality-of-brightness method.

SUMMARY

When a red light was compared with a blue-green light a pronounced reversed Purkinje effect was found by both observers with the flicker method for an illumination of the photometric screen less than 1 meter-candle. The illumination at which the effect appears depends, of course, on the absorption of the optical parts of the photometer and the area of the artificial pupil.

A real Purkinje effect was found with the equality-of-brightness method. The same results were obtained with an equality-of-brightness photometer with and without a contrast field. The writer favors a photometric field without contrast where there is a color difference.

With the flicker method one observer obtained a value for the ratio of R/G when calculated according to the inverse squares of the distances of the red and blue-green lamps from the photometer screen about 13 per cent higher than the value obtained by the other observer for an illumination of the photometer screen of 10 meter-candles. Throughout the whole range of illuminations used (from 0.5 meter-candle to 13 meter-candles) a large difference between the two observers was obtained. The value of R/G obtained by observer L with the equality-of-brightness method was found to be only 62 per cent of its value by the flicker method at an illumination of approximately 10 meter-candles. Observer K also obtained a lower value, which was 76 per cent of its value by the flicker method and 87 per cent of the value obtained by observer L with the latter method.

The fact that the flicker method shows a reversed Purkinje effect seems to be established. While it is known that the two methods of photometry herein considered yield different results, the other data are presented here for the purpose of emphasizing this point.

The writer acknowledges the assistance of Mr. Leonard Krill throughout the experimental work outlined herein.

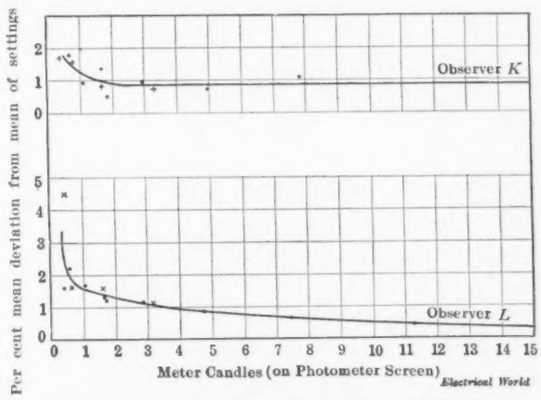


FIG. 2—SENSIBILITY OF THE FLICKER PHOTOMETER

Transmission Tower Design for the Central Colorado Power Company

BY W. E. BELCHER

Several articles have appeared at various times in the *Electrical World* descriptive of the overland high-tension transmission lines and general construction work of the Central Colorado Power Company, and also of the Great Falls (Mont.) Power Company. Both lines employ single-circuit transmission towers whose special features of design as originated for the former company may make a more detailed description of interest.

The Central Colorado tower was among the first to be used for carrying electrical conductors on strings of suspended insulators, which were then in the early stages of their development. The construction of the tower is not unlike that of other styles of tower now in use, in so far as it is made up of light angle sections, galvanized, and arranged to be self-supporting on four main legs. It is believed, however, that the arrangement of parts has shown certain advantages for this design, and it has been found that the tower is well suited to meet the severe conditions experienced on the lines erected in 1908 across the Colorado mountains.

The high-tension distribution system of the Central Colorado Power Company is notable on account of the length of the line, the high voltage used, and the very high altitude and mountainous character of the location.

The length of the line from Denver to Glenwood is 153.4 miles by the way of Leadville, and from Denver to Boulder 28.8 miles, a total of 182.2 miles. The line reaches a maximum elevation of 13,628 ft. at Argentine Pass. The nominal pressure employed is 100,000 volts, the circuit being composed of three No. 0 copper strands with hemp core. On account of the rough topography the spans vary widely in length. Originally, the standard span was to have been 660 ft., or eight towers per mile, but as constructed the average span is greater than this, an average of about six towers being used per mile, with spans varying from 300 ft. to 2900 ft. The 2900-ft. span mentioned is carried, however, by double-circuit towers, a few of which were erected in 1907 previous to the decision to build only a single-circuit line. A number of spans from 1500 ft. to 2000 ft. in length are carried by the single-circuit towers.

By taking advantage of the ridges and high points of the line for tower sites long spans were possible with ample ground clearance, and it was not necessary to follow the profile down into the narrow canyons as would have been necessary with a wood-pole line. The cross-arm used was provided with connections for side-guying so that on the turns no special towers were required. Throughout most of the line only one ground wire was used. This was of Siemens-Martin galvanized stranded cable, 0.25 in. in diameter, pulled up with less sag than the conductors in order to avoid whipping on exposed spans. The cables themselves were drawn up nearly to their elastic limit to

prevent flapping in the wind. They showed little tendency to remain parallel during strong winds, swaying independently with considerably wave motion whenever the direction of the wind was not at right angles to the line. The wind action is very severe owing to the nature of the country (see *Electrical World*, June 1, page 1205). An attempt was made to measure the actual wind pressure at one of the towers located on the Argentine Pass, but the anemometer was broken and the gage board blown away after registering a pressure of 20 lb. per square foot. During certain seasons of the year sleet accumulated on the lines at some of the low places, this amounting to 1.9 lb. per foot of conductor in an instance cited by Mr. P. T. Hanscom, electrical engineer for the Central Colorado Power Company, before the Chicago convention, A. I. E. E., June 26, 1911. The case mentioned occurred, however, previous to putting the line into operation.

Design of Towers

The height of the tower is about 44 ft., leaving 40-ft. clearance measured from the ground line to the three conductors, which hang in a horizontal plane 10 ft. 4.25 in. apart. The minimum clearance between the conductors and any part of the tower is 4 ft. when the insulators are hanging vertically, or 2 ft. 6 in. when they are swung out at an angle of 45 deg. The maximum loading of the conductors was assumed as the resultant of the weight of the wire covered with 0.25 in. of ice all around and acted upon by a wind force of 8 lb. per square foot of projecting area, which corresponds to an actual wind velocity of approximately 60 miles per hour. The test loads were established in excess of any possible reactions on the tower due to this loading with tower spacing up to 1500 ft. They also provided for 2500 lb. unbalanced load at any insulator support, which is the elastic limit of the single No. 0 copper strand at 30,000 lb. per square inch. The test loads and the deflections observed during the test are shown in the accompanying table.

DEFLECTIONS OBSERVED IN TEST OF TRANSMISSION TOWER

Test Loads.	Strain Applied, Lb.	Deflection, In.	Permanent Set, In.
A. Applied to cross-arm end, parallel to line	2,500	4.0	0.50
B. Applied to cross-arm center, parallel to line	2,500	0.5	0.25
C. Applied to cross-arm end, vertical downward	2,500	1.75	0.00
D. Applied to cross-arm end, right angles to line	6,000	2.5	0.25
D'. Applied to cross-arm end, right angles to line	9,500	8.0	Failed

The method of applying these loads to the tower is shown graphically in the accompanying diagram, with the resultant stresses. After withstanding a loading at right angles to the line of 6000 lb., it was decided to increase the load to a breakdown value. This loading is referred to as D', the ultimate strength of the tower, which failed at 9500 lb. by the buckling of the main leg in compression on the side nearest the load, about 3 ft. above the ground.

During a later test the horizontal loading at the end of the cross-arm A was increased until the tower failed. At a loading of 3000 lb. there was a permanent deflection of 5 in., which increased very little at a loading of 3500 lb. At 4000 lb. the cross-arm was severely distorted, but the load reached 4500 lb. before complete failure, which occurred from buckling of the main leg. After removing the load the tower partly recovered, the permanent set being 9 in. When this loading reached 3300 lb. the stress in the main leg was equivalent to that produced by three No. 00 conductors pulling in the same direction when stretched to their elastic limit with all conductors broken on the opposite side.

The tower was designed with an arrangement of parts such that all the stresses produced by loads in any direction at the insulator supports are taken care of in the tower by the four main legs in tension or compression and by four main diagonals. These stresses travel to the ground in straight lines from the point of cross-arm connection, without the customary crossing back and forth through alternate struts and diagonals. The result was to reduce the number of main connections and weight of details, which was essential, as each pound of weight shown on the design has added nearly 3 tons to the total weight of the towers of this style which have been manufactured up to the present time.

Main Leg.—Maximum stress, 11,700 lb. compression; section, one single angle, 2.5 in. by 2.5 in. by 3/16 in.; ratio of length to least radius, $65 \div 0.49 = 133$; area, 0.91 sq. in.; strength, $0.91 \times (27{,}000 \div 2) = 12{,}300$.

This value of 27,000 lb. ultimate strength in compression per square inch is taken from the 1900 edition of the "Pencord Handbook," where results are shown of tests made on struts of medium steel with flat ends, under the

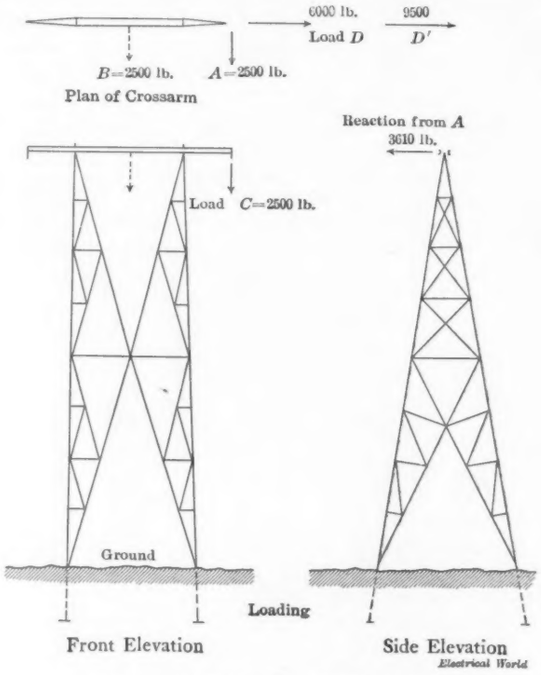


FIG. 1—DIAGRAM OF TOWER LOADING

direction of the late Mr. James H. Christie. This strength is divided by a safety factor of two in the above calculation, to keep below the elastic limit, the assumption being made that the elastic limit of the column in compression is greater than one-half of the ultimate compressive strength. For safe working values for ordinary practice the factor of safety recommended by Mr. Christie varies from 3 to 5.8, being 4.3 for the above ratio of length to radius. When tested to breakdown, this main leg angle failed at 15,800 lb. or 17,500 lb. per square inch. The writer was interested in comparing this allowable stress of 13,500 lb. per square inch with that indorsed by Mr. R. Fleming in his paper presented at the annual convention of the Association of Iron and Steel Electrical Engineers, Milwaukee, Wis., Sept. 30, 1912. His formula B works out almost exactly the same, that is, 13,600 lb.

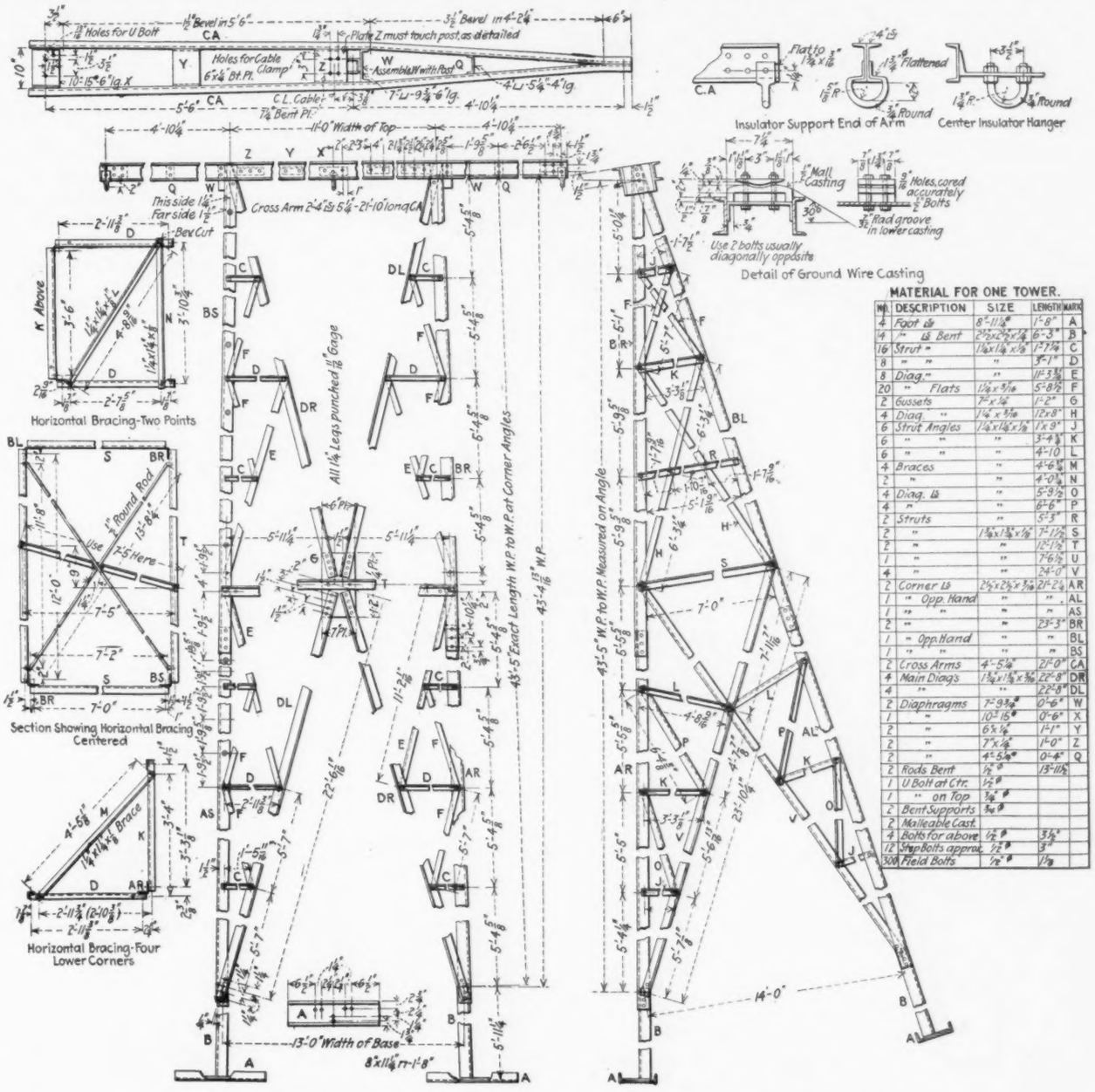
In a structure like this where very light sections are used —often with many one-bolt connections—it is essential that the details of the design be made so as to avoid secondary stresses as far as shop practice will permit. The structure cannot be expected to stand an increase of load which will cause stresses above the elastic limit in any of the mem-

bers, as the distortion brings severe secondary stresses and consequent collapse.

Diagonal.—Maximum stress, 10,400 lb. tension; section, 1¾ in. by 1¾ in. by 3/16 in.; area, 0.62 sq. in.; net area, 0.51 sq. in.; strength (60,000 × 75 per cent) ÷ 2 = 22,500 lb. per square inch; 22,500 × 0.51 = 11,200.

This value allows for a factor of safety of two, applied to the ultimate strength of the material, reduced by 25 per cent on account of connection being made to one leg of the angle only. At the time the tower was tested to shown. This was found to be correct by the test, as after deflecting 1¾ in. under the vertical load (C) the channels resumed their original position upon the removal of the load. The bending moment in the cross-arm due to the horizontal load was taken care of by spreading apart the two channels in the central portion of the cross-arm and connecting them rigidly by short channel diaphragms bolted to the webs. The flanges of the cross-arm channels were not punched.

Web Members and Connections.—The purpose of the web



No.	DESCRIPTION	SIZE	LENGTH	MARK
4	Foot ∠s	8"-11½#	1'-8"	A
4	" ∠s Bent	2½×2½×5/16	6'-3"	B
16	Strut "	1¼×1¼×1/8	1'-7⅞	C
8	" "	"	3'-1"	D
8	Diag."	"	11'-3⅜	E
20	" Flats	1¼×5/16	5'-8½	F
2	Gussets	7"×¼"	1'-2"	G
4	Diag. "	¼"×5/16	12'×8"	H
6	Strut Angles	1¼×1¼×1/8	1'×9"	J
6	" "	"	3'-4⅜	K
6	" "	"	4'-10	L
4	Braces	"	4'-6⅝	M
2	"	"	4'-0¾	N
4	Diag. ∠s	"	5'-9½	O
4	"	"	6'-6"	P
2	Struts	"	5'-3"	R
2	"	1⅝×1⅜×1/8	7'-1½	S
2	"	"	12'-1½	T
1	"	"	7'-6½	U
4	"	"	24'-0"	V
2	Corner ∠s	2½×2½×5/16	21'-2¼	AR
1	" Opp. Hand	"	"	AL
1	" "	"	"	AS
2	"	"	23'-3"	BR
1	" Opp. Hand	"	"	BL
1	" "	"	"	BS
2	Cross Arms	4'-5⅛	21'-0"	CA
4	Main Diags.	1¾×1⅜×5/16	22'-8"	DR
4	"	"	22'-8"	DL
2	Diaphragms	1'-9⅜	0'-6"	W
1	"	10'-15/8	0'-6"	X
2	"	6½×¼	1'-1"	Y
2	"	7"×¼	1'-0"	Z
2	"	4'-5⅛	0'-4"	Q
2	Rods Bent	½"	13'-11½	
1	U Bolt at Ctr.	½"		
1	" on Top	⅝"		
2	Bent Supports	⅝"		
2	Malleable Cast.			
4	Bolts for above	½"	3½"	
12	Stay Bolts appro.	½"	3"	
300	Field Bolts	½"	1⅛	

FIG. 2—SINGLE-CIRCUIT STEEL TOWER, CENTRAL COLORADO POWER COMPANY

breakdown, this angle was carrying 16,400 lb., or 31,800 lb. per square inch.

Cross-arms.—Section 2, 4-in. channels, 5.25 lb. per foot; maximum stress due to side pull on end, 20,000 lb.; length ÷ radius = 28 ÷ 0.45 = 62; compressive strength (40,000 ÷ 2) × 1.1 = 22,500; bending moment, 139,000 inch-lb.; section modulus, 2 × 1.9 = 3.8; maximum stress, 139,000 ÷ 3.8 = 36,600.

This section was used, as it was believed that the elastic limit of the material would not be exceeded by the stress members is to support the main legs at intervals of 65 in., with the use of as little material as possible. The ratio of length to radius is in general kept below 200, minimum size of angle being 1¼ in. by 1¼ in. by ⅛ in.

The connections throughout were made with galvanized bolts ½ in. in diameter, with rolled threads, the maximum calculated load for any bolt being 2600 lb., which is equivalent to a shear per square inch of 13,200 lb. Under the loading D′ at the time of failure of the main leg, the diagonal stress, being shared by four bolts, brought 4200 lb. on each.

This would correspond to 21,300 lb. shear per square inch.

Method of Anchorage

The tower stands upon four angles, each 2½ in. by 2½ in. by ¼ in., buried 6 ft. deep in the ground. The lower end of the leg is bent out and punched for two ¾-in. bolts. The anchorage for each leg is an 8-in. 11¼-lb. channel 1 ft. 8 in. long, laid flat, with upstanding legs, presenting an area against uplift of 1.1 sq. ft. The maximum uplift from the specified test loads amounts to 11,100 lb. on any one of the anchors. This anchor was tested with a direct upward pull when embedded in well-tamped sand. A pull of 20,500 lb. was required to start the anchor, and this pull when exerted for eight minutes raised it 2 in., after which it stopped. The anchor finally came up under a pull of 30,000 lb. The anchor itself showed no signs of failure except for strain lines in the immediate vicinity of the bolts.

A test was made, for comparison, upon another style of footing, composed of two 3-in. by 3-in. angles 2 ft, long, crossed and presenting an area of 1 sq. ft. This anchor, buried as before, came up 3 in. under a steady pull of 11,000 lb. and gave way at 17,000 lb. The buried channel proved satisfactory under all conditions except in solid rock. Very little concrete was used, the holes for the legs being back-filled with the excavated material. On solid rock a wedge bolt was grouted in with sulphur, the top being shaped and drilled to take the standard tower angle. A few of the towers were located on swampy ground and these footings were set in concrete.

Provision for Shipment

The total shipping weight of the tower is 2200 lb., subject to rolling-mill variations of weight. It was found in practice that the weights as received from the mill were from 2 to 5 per cent less than figured, based on weights given in the "Manufacturers' Handbook," which was just about made up for by the additional weight due to galvanizing. On account of convenience in handling, each tower was shipped in several bundles weighing less than 200 lb. each. The bolts and fittings, weighing 200 lb., were shipped in two boxes. The pieces with like marks were first wired together and then these sets again wired in convenient bundles. By dividing in this way the distribution of material along the line was made more easily and accurately. The material was hauled to the nearest accessible point by wagon, being left at points above the tower site wherever possible and from there dragged or carried on mule-back to the site. Shipped in this way, there was very little loss of small parts. The convenience of handling packages of this weight over rough country is to be appreciated when compared with a weight of about 1600 lb. for a wooden pole 45 ft. long.

Methods of Erection

The surveying party when locating the line left center stakes, numbered consecutively, to mark each tower site. The excavation for the anchor legs and the setting of same was done by a Japanese contractor, who took care of his own men and camp. The first contract price for this work was only $11 per tower, but the actual cost to the contractor overran this figure on account of the character of the soil. A great deal of porous lava rock was encountered, which, covered over with a few inches of soil and sagebrush growth, had given no surface indication whatever of its presence to the surveyors. The actual cost of this work is estimated to have been about $14 per tower. Wooden templets, with steel connections at each corner, were furnished, these forms being the exact duplicates of the tower-base and main-leg connections. After the excavation was completed the anchor legs were set in position, connected to the templet and the holes back-filled. Care was taken to get a firm bearing for the legs near the ground surface by tamping in the largest pieces of rock available. An assembling crew bolted the towers together and was followed by a raising crew. This erection force put up from six to eighteen towers per day, averaging about a mile per day where no special construction was necessary. The assembling and erection of the towers, including the guying required, average about $15 per tower.

Estimates which have been made recently show that the first cost of a steel-tower line is less than that of a wooden-pole line where conditions and requirements are similar to these. The pole-line expense is largely due to the cost of handling the poles in rough country as well as to the increased number of expensive insulators and fittings required.

The construction work was in charge of Mr. H. L. Vercoe, superintendent of the transmission lines, acting under Mr. G. H. Walbridge, general manager of the Central Colorado Power Company.

Other transmission lines have since been erected, using single-circuit towers similar to the original towers described, with slight modifications in each case. The more important of these lines, three of which cross the Continental Divide, are as follows, the number of towers belonging to each company being given in each case: Central Colorado Power Company, 600; Carolina Power & Light Company, 187; Madison River Power Company, 536; Great Falls Power Company, 2400; Tennessee Power Company (to date), 1150.

All of the above towers were fabricated by Milliken Brothers, Staten Island, New York, with the exception of those for the Tennessee Power Company, which were made by the American Bridge Company. The Great Falls Power Company has a two-circuit line strung on two parallel lines of single-circuit towers, the telephone line being carried on wooden poles midway between the transmission lines and transposed at every fifth pole. The conductor used is a No. 0 copper strand, medium hard-drawn. Six insulator units are used for the pressure of 102,000 volts with two ⅜-in. galvanized, stranded ground wires. The accompanying illustrations give a good idea of the general construction. The standard span of the line is 600 ft. In mountainous country the towers are erected at distances of from 1200 ft. to 2000 ft.

The span crossing the Missouri River is 3000 ft. long, two standard towers being used in series at each end. At turns the angles were divided up at several points, and auxiliary cross-arms were used below the conductors with an additional string of insulators to hold the wire in position, preventing upward or sidewise movement.

The Carolina Power & Light Company used the same type of tower, with modifications, on its line from Buckhorn Falls to Raleigh. For the telephone line steel strand was used, supported by the towers and carried on cross-arms laid against the slanting braces in the upper part of the tower. This necessitated adding braces to the interior panel between the main legs and the telephone cross-arm.

The Tennessee Power Company line is a single-circuit line, with No. 00 seven-wire copper strand carried on strings of seven insulator units, the horizontal spacing of conductors being 10 ft. 6 in. and the working pressure 110,000 volts. The telephone line is No. 6 copper-clad wire supported on malleable-iron brackets attached to one side of the tower. A top extension is used for supporting the ground wire at the dead-end towers, raising the ground wire about 4 ft. above the cross-arm at the center of the tower. Standard base extensions were provided, 5 ft. and 10 ft. in height, the use of which saved putting in additional towers in many instances.

Further information and description of the Central Colorado transmission lines may be found by reference to articles which appeared in the *Electrical World* Jan. 27, March 9, June 23, June 30 and July 14, 1910; July 8 and Oct. 11, 1911, and June 1, 1912. The Great Falls (Mont.) system was described in these columns July 6, 1912.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Electricity for the Automobile Owner

An expert demonstrator has been employed by the Kentucky Electric Company, Louisville, to explain to owners of electric and gasoline vehicles the facilities afforded by the modern central station for charging power and ignition batteries, pumping tires and operating other electrical conveniences and comforts in connection with the machine. During the recent show of the Louisville Automobile Dealers' Association, a model garage was fitted up in the electric company's window. Here the use of electrically operated tools, vulcanizers, soldering irons, etc., was explained and attention called to the merits of electric foot warmers, cigar lighters, etc.

The Kind of Ice Equipment to Install

Some practical advice is offered to the small operator contemplating the addition of ice-making machinery to his electric-light plant by a Kansas manager who manufactures 2700 tons of ice each year for his local community of 8000 population.

"If you have sufficient generating capacity, put in an electrically operated ammonia compressor, especially if your motor load is light. If, however, your engines are operating non-condensing, their capacity can not only be increased to advantage by installing surface condensers but the condensed water obtained will be available for freezing into ice. If you are now using jet condensers, put in a raw-water plant.

"The ice season is, of course, heaviest when the lighting load is at its lowest ebb, so that an electrically operated plant will assuredly increase the efficiency of your electrical machinery."

The Partnership of the Public

Recognition of the public as a partner with capital and labor in the successful operation of utilities was emphasized by Mr. William McClellan, electrical engineer for the New York Public Service Commission, Second District, in his recent address before the New York Railroad Club.

This new recognition of an always existing relation has been very tardy by all business, said Mr. McClellan. It is seen at present more clearly by public-service men because of the very nature of their business. In the end, it will be found to be fundamental to all. Indeed, it is a truism to say that labor, capital and the public are the three partners that must join in the conduct of any business. Each has resources that the others need.

Business will fail when any one of the three partners fails of proper reward. Business will be unsatisfactory when any one of the three partners neglects to bear its proper share of the burden of direction and support. The public-service company that does not keep this constantly in mind fails as certainly as does the banker or the baker who is neglectful. To recognize it freely and to act accordingly is to be modern in a necessary and practical way.

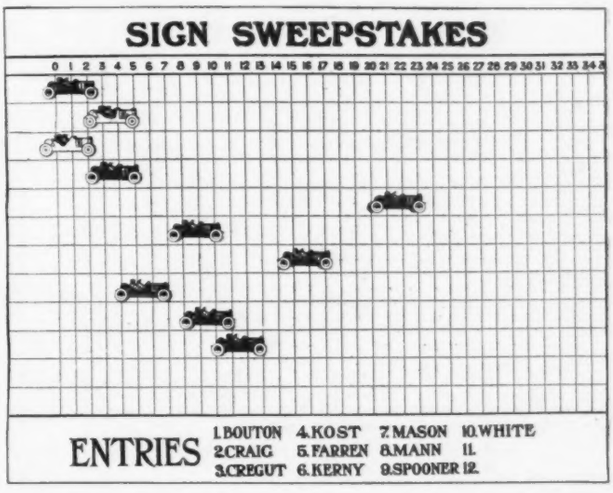
The partners must learn to live and to work together—each respecting the rights of the others. Learning means a process of education—self-education usually and often with much difficulty. Occasionally the dull ones must be gently prodded, the unruly must be given a bit of the rod, and the vicious will assuredly be expelled from the business entirely. And what must be learned?

Capital, which has heretofore regarded itself as the principal or even sole partner, must recognize the equality of the three. It must deny itself dividends that are not earned. It must learn that its chief asset is a property with full service value. It must learn that good service and good wages are as sacred as good dividends.

The public must learn that expenses and proper returns to its partners can come only out of earnings and that rates must be fixed accordingly. It must learn to be willing to pay for what it demands. It must learn that men and material have physical limitations and that allowance therefor must be made. It must learn that the public-service business is its business, and that agitation and baiting are hampering and extraordinarily expensive to all the partners, including itself.

Salesmen's Record Chart

"The Sign Sweepstakes" is the title of a salesmen's chart recently installed at the Third Avenue office of the New York Edison Company. As the illustration shows, it consists of a vertical column of miniature automobiles, each differently colored and numbered. One of these numbers and cars is assigned to each agent of the department. Across the top of the chart is a row of figures representing the number of contracts secured, and each day the cars are advanced by the corresponding amount. The cars can be moved from the rear of the card, the dimensions of



SALESMEN'S RECORD CARD USED BY NEW YORK EDISON COMPANY

which are 38 in. by 43 in., making it large enough to be seen readily across the room.

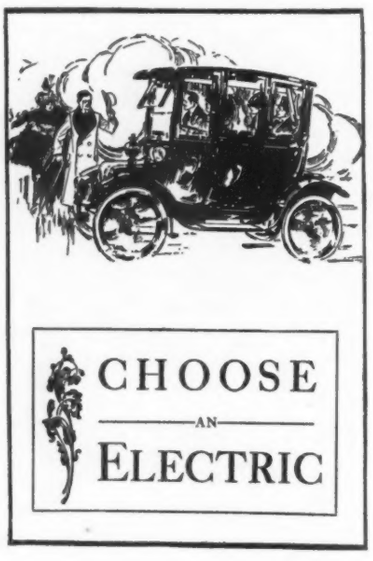
Aside from injecting a spirit of competition among the salesmen, the chart inspires a keen interest in the amount of new business secured. It gives at a glance the exact standing of each agent without the effort required to read a column of figures for comparison purposes.

Line Gang Upheld by Judge

Judge Morson, of Toronto, Canada, has handed down a written judgment quashing the conviction against a number of Toronto Electric Light Company employees on a charge of being disorderly. The men were digging post holes and refused to stop at the request of the police, who were acting under instructions from the city. They were accordingly arrested and a conviction registered against them with the right to appeal. The judge did not deal with the city's right to restrain the company from digging holes or erecting poles, but merely decided that the action of the appellants did not constitute disorderly conduct within the meaning of either the law or the criminal code.

The Electric Vehicle at Dayton, Ohio

During the recent automobile show at Dayton, Ohio, a number of electric vehicles were exhibited. To co-operate with the manufacturers as well as to stimulate interest in the electric-vehicle field locally, the Dayton Power & Light Company distributed a number of folders covering points of interest to prospective users of electric automobiles. These included the schedule of rates for private charging service at Dayton, a mention of the public garage service available locally, a list of the 130 electric-vehicle owners



CENTRAL-STATION BOOKLET

in the city with their addresses, makes of cars, etc., and a brief enumeration of the advantages of the electric vehicle.

For private-garage charging service the Dayton company's rates are as follows, a readiness-to-serve charge of $5 per month being made as the minimum:

Up to 100 kw-hr	$0.0660	1429 kw-hr to 2857 kw-hr	$0.0540
101 kw-hr to 285 kw-hr	0.0635	2858 kw-hr to 4285 kw-hr	0.0460
286 kw-hr to 714 kw-hr	0.0615	4286 kw-hr to 5714 kw-hr	0.0388
715 kw-hr to 1428 kw-hr	0.0560	5715 kw-hr and above	0.0315

A discount of 5 per cent is allowed if account is paid within the discount period.

Another page of the folder directs attention to the advantages of electric over gasoline vehicles under heads as follows:

Economy of Money.—1. Greater simplicity, hence fewer repairs. 2. Lower cost of insurance. 3. More durability than reciprocal type. 4. Less care. 5. No elaborate repair tools. 6. Small loss of power. 7. No need of experienced chauffeur, who must get high wages, with small number available. 8. Freedom from insurance limitations.

Economy of Time.—1. Simplicity of adjustment. 2. No cranking. 3. Instant readiness. 4. Develop power despite conditions of weather. 5. Less time in repair shop.

General.—1. Simplicity of construction. 2. Simplicity of operation. 3. Danger of fire or explosion eliminated; hence wider field. 4. Universality of electric power. 5. No freezing. 6. No tanks to leak. 7. Electric vehicles permitted on docks and terminals where gasoline vehicles are not allowed. 8. No noise. 9. No odor. 10. Advertising feature. 11. Does not spot liveries with grease, or impregnate goods with odor.

Newspaper Electrical Page in Texas Town of 4500

The distinction of having an electrical page appear three times a week in the newspaper of a town of 4500, without even a local electrical contractor to lend co-operation, belongs to the Bay City (Tex.) Ice & Light Company, whose manager, Mr. W. C. Duncan, promoted and carried through the scheme. The seemingly forlorn task of arranging for an electrical page to appear three times a week received its first encouragement from the newspaper itself, which offered a low advertising rate under the conditions that an entire page was to be contracted for. The Bay City electrical page also has the distinction of being the first page of its kind in Texas.

55-Ton Ice Plant Showing 16 Per Cent Net Earnings

One of the comparatively large combination ice-electric plants located in a Gulf State town which has a population of 12,000 yielded during the past season a net income of 16 per cent on the investment. This plant is in operation only four months of the year and during this time employs eight wagons in supplying its retail trade.

The compressor is steam-driven and the distilled water for the ice make-up is obtained from the condensed steam of the several prime movers in the plant. A storage capacity of 120 tons is at hand to help tide over the periods of high demand.

This 55-ton plant represents a total investment of $75,000 and is able to produce ice at the platform for $1.35 a ton. Employing a sliding scale of prices the frozen product is retailed at a figure varying from $5 to $10 a ton, while wholesale consignments are sold at prices which vary from $4 to $5.50 a ton. In 1912 the gross annual income to this central station from its ice business amounted to $30,000, of which $18,000 was spent in operating and charged to interest and depreciation, leaving $12,000 net profit.

Importance of Ice-Storage Capacity

The demand for ice, which varies with variations in summer temperature, can be met most economically by proper cold-storage facilities, since in this way the compressor outfit may be uniformly loaded throughout the dull periods.

Special care should also be taken to design the ice plant so as to secure low labor costs, for, according to the experience of a New Mexico operator who has a 6-ton plant, the item of labor is likely to be expensive owing to the necessity of suddenly caring for a maximum number of "rush" orders. If, however, adequate storage capacity has been installed in advance, such peaks of demand can be met without increased operating expense.

Where the quality of labor available requires close supervision this correspondent further recommends that the output be sold wholesale if satisfactory arrangements can be made. In this way, he points out, the manager can

concentrate his efforts on the plant's operation, at the same time enjoying the advantage that comes from doing a cash business.

Under ordinary conditions he thinks that it will not prove profitable to install a plant of smaller capacity than 10 tons' daily output. He further declares that unless the day business of the electric-lighting plant be almost enough to operate the station profitably throughout the twenty-four hours the cost of running the ice factory may prove to be as great as when operating singly, if not more.

26 Per Cent Returns from Southwestern Ice-Electric Plant

A combination ice-electric plant in a Southwestern town of 2700 inhabitants made and sold 1500 tons of ice during the summer season of 1912. This company has no wholesale market and must rely exclusively upon its retail customers. That the ice consumers of this hot and thirsty village have made the most of their opportunity to purchase the distilled-water product is evidenced by the fact that the ice consumption was more than 1000 lb. per capita.

Distilled water for filling the cans is supplied by the condensate from the steam-driven compressor and the steam engine which drives the lighting generator. The cost of producing a ton of ice at the platform is estimated by this company to be $2. The retail price at which all ice was sold was $5 a ton. The following tabulated figures show the result of the ice campaign which was carried on last year by this busy central station:

Total investment	$12,000
Gross yearly income from ice business	7,500
Net income from ice business	3,400

It will be seen that, although this company unfortunately had no wholesale market for its product, it was still able to show a net return of 26 per cent on the amount invested in its ice business.

Lighting, Water and Ice Plant at Graham, N. C.

Graham, N. C., is a small town of about 2000 inhabitants on a branch line of the Southern Railway running from Goldsboro to Greensboro. It contains a few mills driven by isolated steam plants, and the electric-lighting station is a small affair operated only at night, no day service being available.

About a year and a half ago the Piedmont Railway & Electric Company, backed by Richmond (Va.) capital, built a railway line from Graham to Burlington, a town having fewer than 5000 inhabitants. This railway has thus far been just about able to meet expenses. The Graham Ice Company, which differs from the electric company only in name, manufactures and retails ice in the town and in addition sells coal and wood. At Burlington a municipal plant has been in operation which, besides giving unsatisfactory service, is unprofitable financially.

All of the properties above mentioned have, however, just been bought up by a new company, and the charter of the Piedmont Railway & Electric Company being broad enough, its corporate name is retained by the consolidation. A new station will be built between Graham and Burlington, but until late in the fall the individual companies will continue to operate as they have in the past.

Present Combination Station

The Graham Water & Electric Company and the Graham Ice Company have a combination station under the same roof on the edge of the town adjoining the Southern Railway Company's tracks. The equipment installed consists of a 90-hp Reeves engine directly connected to a 65-kw Crocker-Wheeler 2300-volt, 60-cycle, three-phase alternator. Steam is generated in two 100-hp return tubular boilers fired with run-of-mine coal costing from $3.50 to $3.65 a ton delivered.

In the same engine room there is a 17-ton De La Vergne ice machine and a fire pump for forcing the water from a 100,000-gal. reservoir to a 75,000-gal. tank situated nearer town.

The water is pumped to the reservoir from wells 450 ft. deep by an electrically driven pump and a steam-driven pump, the former being used at night when the electric-lighting plant is in operation. The steam-driven pump is employed when making ice. A De La Vergne condenser collects the steam from the ice machine and the Reeves engine. Circulating water from a well cools the ammonia and steam condensers and also the water used in making ice. The well water has a constant temperature of 55 deg. Fahr., and the distilled water thus treated is still further cooled before entering the cans to about 40 deg. Fahr., in a De La Vergne pre-cooler. The ice is pulled from the cans by means of a hand hoist. Storage for 300 tons is provided. The ice house is insulated with cork and paper, and the temperature within is kept down to freezing by ammonia circulation.

Expenses and Returns

At the present time one day and one night engineer are required in addition to two firemen and two tank men. There is in addition a chief engineer who is also superintendent of the system and attends to all line work, etc. The tank men receive $1 a day, the firemen $8 a week and the engineers $75 a month.

The yearly income from the sale of ice is greater than the income from either electricity or water, being only a trifle less than the water and electricity income combined. The ice is retailed by the company at from 35 cents to 50 cents per 100 lb., depending on the quantity. In ton lots it is wholesaled at $4 a ton. The ice is shipped in ton lots, by wagon and motor truck, 8 to 15 miles to the surrounding villages. The ice season is of five months' duration, while during the rest of the year there is not a great demand for ice.

When the new plant is in operation the ice-making machinery will be transferred to the new station and a duplicate plant installed. The fire and water pumps will then be all electrically driven and the cooling water which is now permitted to run to waste will be saved and all surplus water sent through 1.5 miles of 6-in. main to Burlington, where it will be sold to the city. The change will also be accompanied with extensions of service to outlying towns and a reduction in rates.

Inauguration of New Service

Day and night service will also obtain, and the streets, which are now lighted only on dark nights, will be lighted every night during the year. Customers will also be provided with free carbon-lamp renewals hereafter, and tungsten lamps will be sold at cost less the price of a carbon lamp.

The rate for electricity in Graham is 14 cents per kw-hr. The town pays $40 per lamp-year for fifty-four 250-watt multiple tungsten lamps on moonlight schedule. The rate to be established by the new company will be 9 cents per kw-hr. by meter or 1 cent per month per watt of demand, as limited through an "Excess" indicator. Series tungsten lamps will also be used in place of the present multiple units.

Mr. J. H. Bridgers, Henderson, N. C., will be the president and general manager of the new company, which will be capitalized at approximately $700,000. The new station will contain two 750-kw turbo-generators and will cater to the needs of about 17,500 inhabitants in Burlington, Graham, Haw River, Elon College, Swepsonville and Mebane.

Illumination and Wiring

Peculiar Freak of Lightning

The accompanying illustration shows in a rather interesting manner how difficult it is to protect distribution circuits from lightning and also affords an example of lightning's perversity. The pole shown in the foreground was located in Delaware County a few miles from Philadelphia, and at the time it was struck there were no wires attached to it, but a cross-arm made to bear six pins had been placed in the top gain.

Within a radius of 50 ft it will be noticed there are a trolley wire, positive and negative trolley feeders, a group of trees, the tallest of which is about 50 ft. high; a house equipped with a lightning rod, and a 55-ft. Bell telephone pole with fifty or more wires thereon. Not one of these

RESULT OF A FREAKISH LIGHTNING STROKE

showed any signs of injury whatsoever from the lightning stroke which split the pole of the Philadelphia Electric Company shown in the foreground.

Example of Efficient Machine-Shop Lighting

The accompanying illustrations show the method of lighting the new assembly-room extension of the Heald Machine Company, of Worcester, Mass., one of the newer industrial plants to be completed in central Massachusetts. The company manufactures special grinding machinery, such as is shown assembled in the photograph and is a believer in the importance of good lighting in connection with rapid and accurate production. The shop addition is 100 ft. wide and 200 ft. long and is built of reinforced concrete. Its roof is of the saw-tooth type and the walls are provided with a large proportion of window space. With the ordinary type of building having a plain roof the lighting is usually much better near the outside walls than at the center, but the saw-tooth type of construction supplies the center with practically as much natural light as the outside. The photograph shown was taken with an ordinary camera solely by the illumination furnished by the electric-lighting equipment. The light-colored glass panes seen in the saw-tooth portion owe their appearance to reflection from the interior,

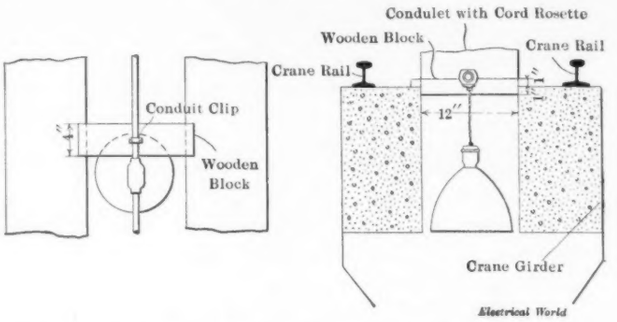


FIG. 1—PLAN AND ELEVATION OF FIXTURE SUSPENSION

their illumination not being derived from any external source of lighting.

A typical plan and section of this portion of the building show it to be composed of bays 20 ft. sq., the roof being supported on four rows of posts running lengthwise. The posts are of reinforced concrete and carry girders supporting traveling cranes. The four rows of posts divide the shop into five sections, so that five lines of traveling cranes can be operated at once over parallel rows of bays, permitting the simultaneous assembly of machines in all five sections. Each crane is equipped with two motors and is controlled from floor handles. The use of a number of small cranes here was considered more desirable than one or two of larger capacity, as many pieces too heavy to be lifted by hand have to be frequently put on and taken off the machines in the process of scraping and fitting. For this reason the saw-tooth roof and multiple craneways met the conditions in the most satisfactory manner, but the problem of artificial lighting was thereby rendered more difficult.

A careful study was made of different styles of lighting in the design of this installation, and this resulted in the selection of 150-watt tungsten lamps and Holophane metal shades with aluminum finish. These reflectors inclose the lamps so that the light is substantially all thrown downward, none being lost in horizontal or upward distribution.

FIG. 2—LIGHTING A MACHINE SHOP WITH 150-WATT TUNGSTEN LAMPS

In the middle of each bay one unit is hung from the roof at a height of 15 ft. above the floor, and between each pair of crane girders are suspended two similar units 10 ft. apart and 10.5 ft. above the floor as shown. Conduit wiring is employed and the lamp cords are hung from condulet fit-

tings carried on wooden blocks laid between the crane girders. The benches are served by smaller lamps hung from the ceiling. At various points on the floor plug receptacles facilitate the attachment of circuits from portable motors operating tools moved from point to point as occasion requires. The shop extension and its lighting were designed by Lockwood, Greene & Company, of Boston, Mass.

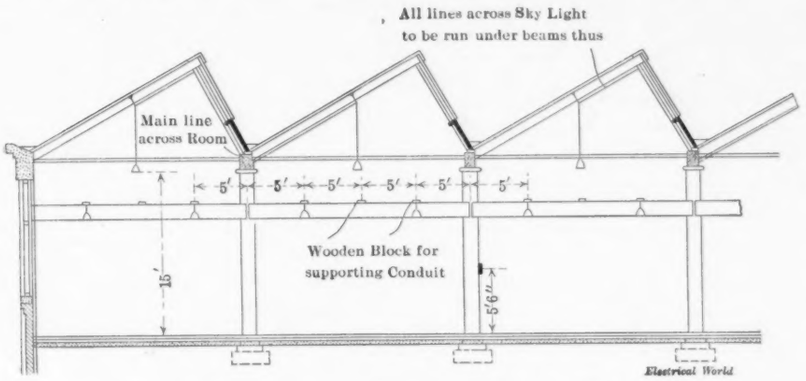


FIG. 3—SECTION THROUGH SAW-TOOTH ROOF

Increased Conduit Construction with Reduced Restrictions

Returning from a visit of several months in Australia, where he investigated local methods of interior-wiring practice, Mr. William Gitt, an electrical contractor of Honolulu, Hawaii, points out some of the directions in which he thinks the English code, there followed, is superior to approved American construction, although he also admits certain essential shortcomings in Australian practice in other respects.

The wiring rules in force in Australia are identical with the English rules drawn up by a committee of the Institution of Electrical Engineers of Great Britain. While many of the provisions are loosely worded and would hardly be tolerated in the United States, a great many more, insists Mr. Gitt, could be adopted in America with profit to ourselves. All inside wiring, for example, must be in conduit.

Among the rules, however, which American inspectors would consider objectionable are:

(1) Permitted installation of conduit elbows of 1.875-in. radius, even when the tube is to be used in non-accessible places between walls or floor and ceiling. Elbows of this radius require that the wire be drawn in when the installation of conduit is first made. They also preclude the possibility of ever drawing out a defective wire and replacing it with a new one, except by demolishing plaster or other interior finish.

(2) The English rules do not require the use of outlet boxes, but permit the bare end of the conduit to project through the ceiling. They also permit a wooden sub-base, hollowed out like a flat canopy, to be fastened to the ceiling at outlets and the rosette or fixture fixed to this.

(3) The rules abroad permit the use of junction boxes with various branch conduits terminating therein, to be installed in non-accessible places.

On the other hand, according to Mr. Gitt, British practice includes several rules which the American craftsman would do well to adopt. These he enumerates as follows:

(1) Permitted use of No. 18 S. W. gage wire for conduit work. This conductor is a trifle smaller than our No. 16 B. & S. gage.

(2) Permitted use of conduit 0.25 in. in internal diameter.

(3) Permitted use of two No. 18 S. W. gage wires in a 0.25-in. conduit.

(4) Rating of current-carrying capacity of No. 18 S. W. gage wire at 7.2 amp.

The net result of these rules is that an average installation of, say, fifteen outlets would cost for labor and material only two-thirds as much under the English rules as a conduit job under our National Code rules.

But, to put it another way, if conduit work could generally be done for two-thirds of the present average prices, it seems possible that it would be used in nearly twice as many buildings as at present. After twenty-odd years' experience in the contracting field, Mr. Gitt declares that the deciding factor whether knob-and-tube or conduit construction is to be used is always the difference in cost, so that a reduction such as mentioned above would, in a great many cases, result in an immediate choice in favor of the safer installation.

Actual test will show that it is just as easy to pull two English-made No. 18 S. W. G. wires through a 0.25-in. conduit with four quarter bends as it is to pull two No. 14 B. & S. wires through a 0.5 in. conduit with the same bends. The abrasion of the insulation after drawing the wire through twenty-five times in the former case was practically nil.

The size of No. 14 wire is certainly, therefore, not required for mechanical strength, he thinks. As to carrying capacity, the National Code gives 6 amp as safe for No. 16 B. & S. rubber-covered wire, and this is 660 watts at 110 volts. There would therefore be no overloading of circuits or excessive drop, especially in the average residence where lengths of run are short. No. 16 B. & S. shows only 2 per cent drop when delivering 6 amp a distance of 40 ft.

In conclusion, Mr. Gitt is firmly convinced that the fire hazard would be distinctly lessened by the adoption of 0.25-in. conduit and No. 16 rubber-covered wire of about the same insulation as the rules require for fixed wire.

Anybody who has ever "shot trouble" for a lighting company, he reminds us, can tell some significant tales of old clothes, trunks, tools and other rubbish thrown into the attics on top of the lighting wires. Under such conditions, he insists, a conduit job would be much the safest.

Recent Telephone Patents

Improved Transmitter

In a transmitter invented by Mr. R. Royal, of Chicago, the chief feature is the means of transmitting the motions of the diaphragm to the microphone button. In this transmitter a flat spring is bent to the shape of a figure 3. The middle point is secured to the movable electrode, while the two ends are secured to an insulated base plate which is securely mounted upon the bridge piece. The bridge carries the button in the usual manner, and thus an initial tension adjustment of the button may be effected. The diaphragm bears upon the two bows of the figure 3, the points of contact being provided with insulating studs. The patent is assigned to the Corwin Telephone Manufacturing Company.

Switchboard Circuit Systems

A patent granted to Mr. H. P. Clausen, of Chicago, and assigned by him to the Stromberg-Carlson Telephone Manufacturing Company, describes a cord circuit system for common-battery operation. According to this system, the cord circuit is divided at its center by the insertion of a repeating coil, the middle points of the two windings of the repeating coil being joined respectively through two condensers. The battery feed is obtained through supervisory relays, two such relays being used for each

end of the cord circuit. It will thus be understood that the battery feed is accomplished by means of the retardation effect of the relays, while the trunking is effected by means of the inductive effect of the repeating coil.

Mr. A. H. Dyson, of Chicago, has obtained a patent for a switchboard circuit system including a trunking system, which is more particularly designed for connecting a common-battery central office with a central signaling office. With the central signaling office the transmitters of the stations are energized by local batteries, but the signaling is done by common batteries. This system provides the features usual for such a circuit scheme, the invention being concerned chiefly with the details of the parts and their arrangement.

Another patent granted to Mr. Dyson also covers a switchboard circuit system which involves trunking. The trunking system is adapted to meet a particular type of line circuit and its arrangement is therefore made with this in view. One of the features of the invention lies in the use of two parallel relays, one of high resistance and one of low resistance, so arranged that when the supervisory light of the subscriber's cord circuit is to be extinguished the high-resistance relay is cut in and when this light is to glow the low-resistance relay is connected. Both of these relays perform the same function at their contacts, the condition of the called subscriber's cord determining whether the high-resistance or the low-resistance relay shall be in service.

Both of the above patents have been assigned to the Stromberg-Carlson company.

Letters to the Editors

Change in the National Electrical Code

To the Editors of the Electrical World:

Sirs:—Concerning the proposed change in the National Electrical Code whereby fuses of refillable construction would be approved, it may be stated that the entire proposition resolves itself into the question whether or not there would be greater abuse of approved fuses (including the refillable type) under the new wording of the code than now exists. Manifestly any conclusion at this time must be in the nature of a psychological speculation, not being based upon experimental facts, and any decision arrived at should be governed entirely by what is for the best interest of the electrical industry. If it is shown that the change of the code as proposed will cause a greater abuse of approved fuses, including refillable types, than now exists, it would clearly be for the interest of all that such change be avoided, but if, on the other hand, under the new revised code less abuse will prevail, then the change is a good one and should be encouraged.

Owing to their defective plan of construction, considerably over 75 per cent of the various types of refillable fuses that have appeared on the market during the last few years cannot be approved by the Underwriters until they are greatly revised. They, therefore, drop out of consideration and do not come within the scope of the present question. It is reasonably certain that no form of refillable fuse will be approved that does not, as submitted to the Underwriters' Laboratories, comply in every detail with the present specifications, except the clause relating to refilling, and that will not be refillable by the user so as to maintain the same degree of accuracy and dependability. Any variation from the specific instructions of the manufacturers as to how their fuses should be refilled, as approved by the Underwriters, will constitute an abuse of the fuses.

It is the contention that serious abuse of the present approved fuse has given excuse for the introduction of a refillable fuse and has raised at this time the question of a revision of the code. Abuse of fuses must result either from deliberate intent or from lack of information on the factors that affect their variation. A very large percentage of the specific causes of abuse detected and recorded by the electrical inspectors relate to the substitution of copper wire in the cartridge or the use of a small auxiliary strip soldered to the ferrules or of a small jumper wire between the cut-out clips employed to prevent too frequent blowing of the fuses after the maximum capacity of the cut-out has been reached. It is difficult to see how the refillable-fuse construction will change the mental attitude of the attendant toward such cases, as the carrying capacity of an approved refillable fuse would be the same as that of the standard fuse. It would therefore appear that a large percentage of the abuses now experienced would continue after the proposed change in the code went into effect. Moreover, a large number of users who have been restrained from this form of abuse by the influence exerted by the Underwriters, through their electrical inspectors, in behalf of safe construction would then avail themselves of the opportunity to increase the carrying capacity of the fuse without discovery.

In addition to the above deliberate attempts to increase the carrying capacity of the fuse, there would necessarily creep in a vast number of abuses through lack of information regarding the factors that affect fuse operation. Anyone familiar with the difficulties of building a line of fuses to comply with the present code specifications will appreciate that any slight variation in assembling the fuse, or in quantity of filler used or condition of that filler, will suffice to throw the fuse outside the code specifications and thus condemn it. It is difficult to imagine that any fuse can be so accurately constructed that after being reloaded by many different users in its life of from five to ten years it will maintain the standard that was required of it when it was originally approved. It would seem that the Fire Underwriters would hardly care to assume the responsibility of placing their approval upon that fuse when it had come into the hands of parties of whom they knew nothing. In the majority of cases it would be fair to assume that the user refilling the fuse would not be conversant with all of the factors affecting its operation. Under present conditions the Underwriters know that if the fuse is returned to the manufacturer defective parts are replaced with new material and the same degree of care is exercised in refilling as with the fuses when new.

In view of these facts, it would seem beyond question that the introduction of a refillable type of fuse into general use would result in a much greater abuse of approved material than is now encountered, and therefore would result detrimentally to the electrical industry.

C. T. McDonald,
Chief Engineer Chicago Fuse Manufacturing Company.
Chicago, Ill.

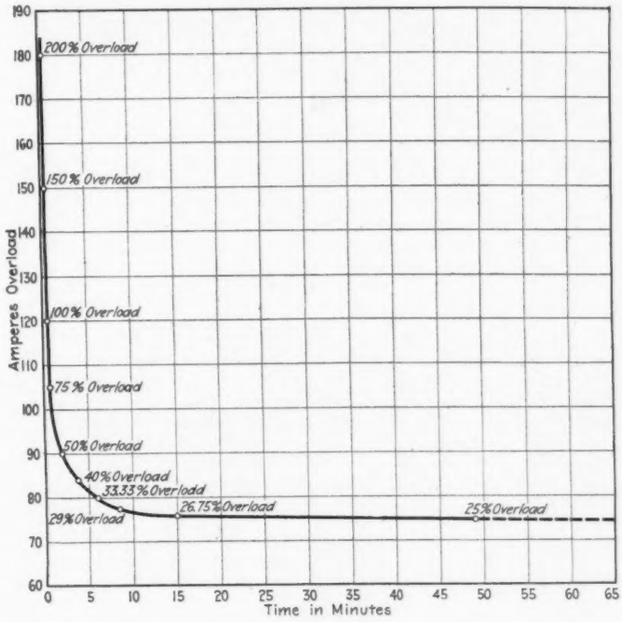
To the Editors of the Electrical World:

Sirs:—Any manufacturer of approved fuses to-day can easily change the arrangement of his fuse so that the fusible element may be readily replaced when melted. It is necessary merely to provide means for clamping the element to the fuse terminal. The company with which I am associated has had a great many requests for fusible elements so arranged that the fuses may be reloaded by the user. Many good customers have been lost on account of the stand taken against such refilling, but we have always felt that the policy with reference to furnishing elements was a step forward toward higher standards.

The accompanying illustration shows an overload-time-characteristic curve of a 60-amp, 250-volt fuse. The curve would coincide with the vertical axis if the load were so large that no time elapsed between the closing of the circuit and the operation of the fuse; this condition is ap-

proached on a "dead" short-circuit. The curve becomes parallel to the horizontal axis at a current value equal to the maximum carrying capacity of the fuse. Fuses in service are blown under conditions between a slight overload and a dead short-circuit. The first condition involves heat dissipation and accurate rating; the second involves the smothering of the arc and providing strength to withstand the explosion when the fusible element is volatilized in almost zero time.

Some idea of the pressure on an inclosed fuse when short-circuited can be gained from a letter by Prof. F. A. Laws, of the Massachusetts Institute of Technology, in part as follows: "I have made certain tests on the pressure occurring when fuses are blown on short-circuit. My experiments are not complete, but I will say that for the conditions under which I worked the pressure was from 250 lb. to 400 lb. per sq. in. maximum. Different circuit conditions would probably vary the figures. Great accuracy, of course, is not possible in such work. There is considerable difficulty in making a pressure gage which will



CHARACTERISTIC CURVE OF A 60-AMP, 250-VOLT FUSE

operate in, say, five-thousandths of a second with accuracy. However, I think that the overrunning on the gage did not exceed 5 per cent."

Pressures of from 250 lb. to 400 lb. per sq. in. are not to be taken lightly. What could be the result except a dangerous explosion if improper materials such as copper and aluminum whose vapors expand rapidly were used, and what if an element were used with a fuse larger than that for which the case was designed and specified by the National Electrical Code, and what, too, except a fireworks "flower-pot" if the filling—the arc-smothering material—were omitted?

The writer believes that to allow the public to refill fuses and take the matter out of the hands of the Underwriters cannot help but result disastrously to property and to humanity as well. An inclosed fuse with an improper element in it, or a badly designed element, is really very dangerous. It may produce fire on a long-time overload and is dangerous to life because of the resultant explosion and also the fire on short-circuit. The writer firmly believes that the number of fuses which are wrongly reloaded to-day is practically insignificant compared with the number of fuses used properly. Of all the fuses which have been returned to our factory to be refilled, not one made by us had been tampered with. Inclosed fuses are not abused to-day, except, perhaps, in a few isolated instances, and I believe that these can be controlled easily by the Underwriters themselves, if they desire to do so. What is needed is merely education and co-operation between the Underwriters and the fuse users.

The writer is certain that if the public is allowed to refill fuses the number of accidents and losses will be so great that the days of the inclosed fuse as a reliable, scientific and efficient protective device will be numbered. A refillable fuse will bring back into use the most objectionable type of contact found—the screw-clamp contact. The screw clamp will not be placed outside the fuse where an inspector can determine at a glance whether or not it has been abused, but will be inside where it can and will be abused and remain undetected.

Fuses were standardized some years ago because of the number of types and sizes and the fact that the fuses of no two manufacturers would interchange. This same condition will be produced again if refillable fuses are approved. No jobber would attempt to carry in stock all of the different types of links and filling materials necessary to furnish the trade with the large number of proper fusible elements and filling materials for the special designs of all manufacturers.

Present standards should not be lowered; they should be raised. Fuses should be safe to property and to persons. There should not be put in the hands of the general public something which under any possible condition may be dangerous.

B. D. HORTON,
Electrical Engineer Detroit Fuse & Manufacturing Company.
Detroit, Mich.

To the Editors of the Electrical World:

SIRS:—For a number of years, perhaps the past fifteen, several types of refillable fuses have been brought forward and thrust upon a market ready to be convinced as to their value. A large number of purchasers became interested in these fuses while the refillable theory was in its infancy, but as none of the fuses was practical or accurate to any sufficient degree, a prejudice soon began to be apparent against the refillable type of fuse. This prejudice soon extended itself to fire underwriting boards, to fire prevention bureaus and to all other bodies whose duty it was either to approve or reject electrical apparatus the use of which might invite disaster.

Several types of refillable fuses from time to time were submitted for approval to local fire prevention bureaus and the National Board of Fire Underwriters, and each was rejected. During the past five years two or three manufacturers of refillable fuses have succeeded to some extent in overriding this prejudice and antipathy, and although they have not as yet received the support and approbation of the National Board of Fire Underwriters, they have succeeded in demonstrating conclusively to a large body of fuse users that there is a great deal of merit in the refillable type.

The past five years have seen these two or three larger manufacturers seeking the approval of the National Board of Fire Underwriters, more because the approval by this board would remove all existing discredit upon the refillable-fuse type of construction than on the theory that the approbation of this board is a prime requisite to its utilization.

The refillable fuse has suffered long from the arbitrary rulings of various associations, but the day of prejudice and unreasonable attitude has begun to fade and the refillable fuses will, I believe, surely receive in the near future the approval of these bodies.

JAMES ARTHUR NOBLE,
Secretary-Treasurer Ackley Brake & Supply Company.
New York, N. Y.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Thawing Water Pipe with Series Transformer

Use was made of an 80-amp series transformer in thawing out a frozen ¾-in. water pipe in a substation of the Yonkers (N. Y.) Electric Light & Power Company during a recent cold snap. The series transformer used had a ratio of 16 to 1, and for the thawing work its secondary winding was connected in series with a bank of eight 80-watt lamps, fed from a 110-volt circuit. For each ampere passing through the secondary winding approximately 16 amp was thus delivered to the pipe circuit. With the nearly 100 amp available in the pipe-thawing circuit when the transformer was connected as described, it required only eight minutes to free the pipe and set the water running. The total energy registered on the meter amounted to about 42 watt-hr., which at the company's lighting rate of 13 cents per kw-hr. would have cost barely half a cent.

Improving Boiler Performance

In a discussion following the reading of a paper on "Steam Flow Meters" by Mr. C. R. Matheny, of Chicago, at the recent convention of the Minnesota Electrical Association, Mr. F. A. Otto, of St. Paul, commented on the number of appliances offered to the plant manager to increase the efficiency of boiler operation. The steam-flow meter is one of these. It must be used intelligently to be of value and must be checked up at intervals. The best piece of apparatus that can be put into a boiler room, however, is an efficient fireman, said Mr. Otto, and the labor required to educate the fireman is well spent. The CO_2 meter is also a valuable help to detect waste.

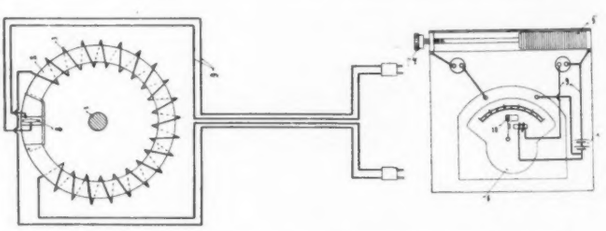
Mr. T. D. Crocker, of St. Paul, told of a generating plant whose rating had been increased from 16,000 kw to 56,000 kw with an increase in boiler capacity of from 11,000 hp to 18,000 hp. This was accomplished by the use of improved generating units, with low-pressure steam turbines; further, the entire boiler plant was worked at 50 or 100 per cent overload during the peak and nearly all of it at normal rating at other times.

Split-Core Instrument for Measuring Large Direct Current

For measuring large direct current without interrupting the conductor, using a principle already applied to alternating-current measurements, the Pacific Gas & Electric Company has constructed instruments for laboratory and underground-cable testing, under patents granted to Mr. O. A. Knapp, of Oakland, Cal. The devices as built have proved to be as convenient and useful as the alternating-current split-core ammeter. The range of application for the direct-current outfit is even larger, since the length of connecting cord has no effect upon the calibration. The device is therefore also adapted for long-distant measurements and recording.

Of the two instruments built for the company, the one for laboratory work has been used with good success and high accuracy for measuring currents from 1000 amp to 10,000 amp, the accuracy being as good as a high-drop shunt instrument will permit. The instrument for underground cable work is designed for currents up to 1000 amp, and the results of tests already made demonstrate its value in distribution work. It is a very rugged instrument and said to be fool-proof. The split core weighs 7 lb., and the ammeter, including rheostat and battery, 6½ lb. Each of these apliances requires only one man to operate it.

The accompanying illustration shows the simple principle involved in these instruments. The current flowing through the conductor sets up a magnetic flux in the soft-iron core. This flux the tester opposes by sending through the winding a current which produces 1000 ampere-turns for the 1000-amp outfit. This opposing current comes from the battery, is regulated by a rheostat and is indicated by a 1-amp direct-current ammeter, the whole contained in a small portable box. A slight turn of the knob raises the current and deflects the ammeter needle to any part of the scale, the latter being marked "0 to 1000." The moment the ammeter needle passes the scale point which numerically equals the line current, the flux in the core, which has previously drawn the small pivoted magnet needle to the left, reverses, throwing the magnet needle to the opposite side, thus closing the circuit and at the same insant throwing the "read" signal to the right. The



SPLIT-CORE INSTRUMENT FOR MEASURING LARGE DIRECT CURRENTS

read signal indicates directly on the scale plates on the ammeter just below the scale and gives the signal for the tester to read his ammeter. When the exact reading is reached by the ammeter needle the signal will start to vibrate rapidly, like the vibrating reed of a frequency indicator, producing a plainly audible buzzing tone. As long as the ammeter needle is above the correct reading, the signal will stand to the right; as long as the ammeter is below the correct reading, the signal will stand to the left, thus enabling the tester to close up on the correct reading instantaneously.

By observing a simple little rule, particularly on low amperages, a very high accuracy is obtained. The tester raises his reading to twice the amount given by the read signal and then, going up and down a few times with the needle, closes up gradually on the current reading. If the average of a fluctuating current is being determined, no demagnetizing is required, as the magnetic lags and leads average, of course, just as the lags and leads caused by the damping of the average indicating instrument. The procedure, therefore, to obtain average currents on fluctuating currents, as, for instance, in testing watt-hour meters on railway circuits, is simple.

The tester deflects the ammeter needle up and down the full scale, and reads every time the signal is given by the read signal. The average of these readings is likely to be a truer average of the line current than the average

obtained from the same number of readings taken from a direct-indicating ammeter. External fields produce very slight effects, since all stray lines near the magnet needle are shunted off through the core instead of through the air-gap in which the needle moves.

The Prevention of Accidents

One feature of the work of the Minnesota Bureau of Labor, Industries and Commerce is co-operation with organizations of employers and others in the work of preventing industrial accidents. In line with this policy Mr. D. D. Lescohier, an expert of the bureau, read a paper on "Prevention of Accidents" before the St. Paul convention of the Minnesota Electrical Association on March 11. The author gave statistics to show that the number of accidents in Minnesota plants is all too large, the one mitigating circumstance being that the total is decreasing.

Linemen appear to be the greatest sufferers in accidents growing out of electrical work. They are killed or injured by contact with high-potential wires, by falling from poles and, rarely, by being struck by falling poles during construction work. More active efforts should be made to cover all neighboring wires with rubber shields during work on poles carrying live wires. Usually the wire which is occupying the lineman's attention is not the one that causes the trouble. Requirements as to safety precautions on overhead circuits should be stringent and should be uniform in the various states. The foreman should be held rigidly accountable for the use of protective devices. He holds the key to the situation, and on him should the responsibility be concentrated.

To prevent falls from poles the speaker said that safety straps should be used under all circumstances. Here again the foreman should be looked to.

Power-plant accidents are usually due to contacts with wires or apparatus carrying dangerous potentials, to unprotected shafts or to falls from platforms or elevated structures. The remedy in the case of the contact hazard is not only to shut off the electricity on the circuit or circuits being repaired but to lock the controlling switch or switches. Specific rules to this end should be promulgated and enforced.

Mr. Lescohier praised the book of safety rules of the Minneapolis General Electric Company. Central-station men, he said, are apt to underestimate the dangers of their business, and a corresponding statement is true of all industries. The grounding of the frames of switchboards controlling circuits of 250 volts or over was recommended. The practice of the Illinois Steel Company and the Oliver Mining Company was commended. It is no evidence of courage or cleverness to be indifferent to the dangers of electricity, said the expert. Shafts should be covered with shields or heavy wire screens.

Strong railings should be used in all portions of power houses where there is danger of falling. Stairways should take the place of ladders where possible. Platforms, scaffolding and the like should be made very secure. The collapse of scaffolds is inexcusable. The statement was made that ladders caused more accidents in Minnesota during the last two years than most of the machines that are well recognized as dangerous. The International Harvester Company has given especial attention to the proper design and use of ladders; for instance, as to the kind of base to prevent slipping on various floors.

Mr. Lescohier's closing word of advice was to pay the greater attention to the man rather than to the thing. Organize safety committees among the men. The employees must be thoroughly imbued with a sense of their own responsibility. The Minnesota Bureau of Labor has worked out a complete plan of organization for the formation of workmen's safety committees in the smaller industries.

The lecturer exhibited a number of photographs, some showing switchboards entirely protected by screens. The electrical men did not think this ordinarily practicable, but in the main they agreed with the bureau expert.

Mr. Eugene Holcomb, manager of the Consumers' Power Company, St. Paul, emphasized the point that men became careless.

Mr. R. F. Pack, manager of the Minneapolis General Electric Company, said he believed that in 1912 his company had no fatal accident and told of its safety rules.

Mr. H. J. Gille, assistant general manager of the St. Paul Gas Light Company, said that his company has used a set of safety rules for a number of years. He spoke of the value of cut-out switches and thought an investigation of the subject very important.

Mr. A. Larney, of the Minneapolis General Electric Company, pointed out that it is not always practicable to switch out high-potential wires needing attention. Some industries dependent on central-station energy would be seriously embarrassed if this were done.

Mr. E. T. Street, of St. Paul, declared that it is often impossible to "kill" all the wires on a pole to effect repairs on a certain circuit. What ought to be done is to devise plans so that the work may be done in safety without resorting to this drastic alternative.

Mr. G. Fabianke, of Sherburne, excited interest by the statement that in his town the Council gives the electric-service company permission to remove trees where the latter interfere with the company's wires. Mr. Ludwig Kemper, of Albert Lea, admitted that, although he is in the electric-service business, he would rather see the trees than the poles. He advocated co-operation with the owners of shade trees.

Simple Circuits for Wireless-Telegraph Station

Kindly specify the simple practical circuits necessary for the operation of a wireless-telegraph station. C. D. O.

For a receiving station the necessary circuits and apparatus consist of an aerial connected to ground through a tuning coil, and a condenser in series with a detector which is shunted around the tuning coil. A 1000-ohm telephone receiver bridged around the detector completes the necessary equipment. In the sending circuit the key, the battery and the primary of the transformer coil are connected in series. The aerial is now connected directly to ground through a spark-gap. The secondary of the transformer coil and a condenser bridge the spark-gap and complete the sending apparatus necessary for operation of a small station. The aerial need not be so extensive as is generally supposed. In many instances an iron fire escape can be made to serve as an aerial for a small receiving station.

Unequal Heating in Transformers

We have two small transformers which are serving in a mining installation connected in series. In one transformer the heating is much greater than in the other. What reason would you assign for this? Is the action the same in polyphase as in single-phase systems? A. K. W.

If two transformers are connected in series there is no certainty that they will divide the potential equally between them, the exact division depending upon the characteristics of the magnetic circuits. The three-phase system, in which all of the electrical apparatus is star-connected, has been found to possess somewhat the same characteristics. The neutral may drift out of its proper place and there will be unequal potentials between it and the three conductors of the circuit, due to unequal loading and differences in transformers or in transmission circuits. Such unbalancing would cause unequal heating of the transformers, and when a four-wire, three-phase system of distribution is employed it may seriously interfere with the voltage regulation.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Alternating-Current Commutator Motors.—L. Barbillion and F. Claret.—In a continuation of their serial on the operation of single-phase commutator motors the authors discuss with the aid of formulas and diagrams repulsion motors with two systems of primary fields and repulsion motors with two sets of brushes, and then give the theory of commutation in commutator motors.—*La Houille Blanche,* December, 1912.

Lamps and Lighting

Street Lighting.—An illustrated description of a system of electric street lighting used at Southgate, England, and specially adapted for tramway roads. The essential feature is the use of 50-cp metallic-filament lamps upon the tramway span wires, in suitable fittings, at a considerable height over the roadway, a few feet from the curb line.—London *Elec. Eng'ing,* Feb. 27, 1913.

Shades and Reflectors.—J. G. Clark and V. H. Mackinney.—A paper read before the (British) Illuminating Engineering Society. The paper begins with some remarks on the need for efficient shading and the choice of suitable methods of screening and directing light. The chief functions of a shade are analyzed and the results given of a series of tests of the distribution of light from various shades and reflectors with gas and electric lamps. Subsequently an account is given of some experiments on the shadows cast by various sources, and direct and indirect lighting are compared in this respect. Some new apparatus for this purpose is described and illustrated. In conclusion appendices are added containing a brief account of four installations, illustrated by photographs taken entirely by artificial light. These are selected with a view to illustrating special points in shading.—*Illumin. Engineer* (London), March, 1913.

Generation, Transmission and Distribution

Norwegian Power Plant.—J. Garstad.—An illustrated article on the water-power station of the city of Trondhjem in Norway. The first plant was erected in 1900 with a rating of 10,000 hp, and a second additional plant in 1910 with a rating of 18,000 hp. Since the city of Trondhjem has 48,000 inhabitants but only a few industrial plants, it was important to attract as many of the inhabitants as possible as customers, and for this purpose a flat rate of charging was devised. But at the same time the consumers were at liberty to install meters and pay according to the amount of energy used. The flat rate has given very good results. There is one house connection per nineteen inhabitants and one consumer per five inhabitants. Out of the 9500 consumers of electric energy for lighting purposes only 100, with connections amounting to 230 kw, have watt-hour meters and pay according to the energy consumed; 1000 (with a rating of 1800 kw of connections) have maximum-demand indicators or apparatus limiting the power, and 8400 (with a rating of 1400 kw of connections) pay a flat rate per lamp. From the consumers with watt-hour meters the station received in 1912 $16.75 per kw or $40 per consumer, while the consumers with maximum-demand indicators or limiting devices paid $25 per kw or $45 per consumer, and the consumers with flat rate per lamp paid $45 per kw or $7.50 per consumer. Even if the lamps installed for a flat rate are used twice as much as the lamps metered in the hours of maximum load, the flat-rate consumers are more advantageous to the central station than the consumers who have meters. In Trondhjem the yearly hours during which the flat-rate consumers use electric energy are from 1200 to 1500, but when electric cooking and heating become more general this may increase to 3000 hours. Load-factor curves are given.—*Elek. Zeit.,* Feb. 20, 1913.

Power Requirements of Fans and Blowers.—C. W. Drake.—After a description of the features of centrifugal fans, disk or propeller fans and positive-pressure blowers, the author gives formulas for calculating the power requirement from the volume of air handled and the pressure of vacuum obtained. In making recommendations for motors to be used as driving blowers or exhausters it should be remembered that the name-plate, size or number gives no indication whatever of the amount of power required. The same fan will require many times as much power in some conditions of service as will be required under other conditions. If the volume and pressure are known, the application is a simple one, but for some purposes the only way in which the required volume and pressure can be satisfactorily determined is by trial.—*Elec. Jour.,* March, 1913.

Development of Water-Powers.—Leon Mähl.—A report to the Fourth Congress of Public Works in Paris discussing the technical and commercial factors which must be taken into consideration in the development of water-powers, especially with respect to the height of the falls.—*La Houille Blanche,* January, 1913.

Modern Condensing Systems.—A. E. Leigh Scanes.—A paper read before the (British) Institution of Mechanical Engineers. The object is to indicate as briefly as possible the lines along which development in condensing systems has taken place during recent years and will probably continue in the future. It is shown that the tendency is toward smaller and cheaper plants of high vacuum efficiency and toward simplicity in auxiliaries as exemplified by rotary pumps.—London *Engineering,* Feb. 21, 1913.

Traction

Single-Phase Traction in Europe.—An illustrated description of two European single-phase railways. The first is the Mittenwald electric railway of 105 km (63 miles) length, running through mountainous districts in Bavaria and Austria. For transmission an emf of 50,000 volts is employed and special care was taken in choosing a suitable type of insulator. The overhead line follows a series of sharp curves, and the poles have to withstand the jerks produced by the swift motion of the current collectors. Investigation showed that only chain-link (disk) insulators would withstand this heavy stress, no part of these insulators being exposed to traction or inflection strains. The type of insulator ultimately developed possesses a breaking strength of from 7800 kg to 8000 kg (about 3600 lb.) with a weight of only 2.8 kg. It also possesses excellent insulating qualities. An essential difference between this insulator and those used by American engineers is that the channels are not of circular cross-section, and instead of a wire rope exposed to rusting, steel bands applied throughout their width on the porcelain (so as not to injure the enamel) are used to fix it. After fitting the insulators in position, the channels are filled in, thus preventing any water from entering and freezing within the insulator. An-

other distinctive feature is the flexible armature of the insulator, which absorbs all shocks, thus preventing any damage to the enamel. The rolling stock of the Mittenwald railway at present comprises nine locomotives, each having a normal output of 800 hp. The maximum gradient of 36.4 per mile is found extensively on this railway; each locomotive will haul over this gradient a gross train weight of 124 tons at about 30 km per hour, which corresponds to a tractive effort of about 7500 kg. The driving motor is a twelve-pole single-phase commutator machine of 800 hp normal output, at a speed of 30 km per hour. It is designed on the A. E. G. system, in accordance with which the current in the armature is produced by transformer effects. The rotor winding is closed by short-circuiting brushes, thus obtaining the secondary winding of a transformer, the primary winding of which is the field winding of the stator. Excitation is effected from the rotor, current being supplied to the armature through another pair of brushes from a special exciter transformer connected up in series with the stator winding. A brief discussion is added of the Rjuken railway, which is the first standard-gage electric railway in the south of Norway to be installed on the single-phase system. It is mainly intended for the transport of the artificial saltpeter manufactured in Saaheim to Notodden. The rolling stock comprises three four-axle and two two-axle locomotives. The former have two bogie trucks and are fitted with four alternating-current motors, each having an hourly rating of 125 hp and weighing approximately 46 tons. The two-axle locomotives have two motors of the same size and weigh about 23 tons. The locomotives are constructed for a line pressure of from 10,000 volts to 11,000 volts at from 15 cycles to 16 cycles and are designed for contactor control.—London *Elec. Review*, Feb. 28, 1913.

Installations, Systems and Appliances

Austrian Central-Station Statistics.—L. ROSENBAUM.—The Austrian central-station statistics compiled by the Electrical Society of Vienna have been enlarged in the present year by including statistics of Austrian railways, giving data on sixty-four electric roads with 1040 km (624 miles) length of track. The central-station statistics give data of 854 public central stations in Austria. Of these 335 are owned by municipalities and 519 are privately owned. There are 143 central stations transmitting energy over districts for agricultural purposes. Since there are 2000 cities and towns in Austria in which electric energy is sold, there must be 1150 cities and towns which are supplied with energy from a power station in a neighboring city. On Jan. 1, 1907, there were 446 central stations (with a generator rating of 168,850 kw); on July 1, 1910, there were 675 central stations (318,614 kw), and on Jan. 1, 1913, there were 854 central stations (457,010 kw). The systems used by the different stations are as follows: 309 stations (71,863 kw) use the direct-current system with storage batteries; 182 stations (6653 kw) use the direct-current system without storage batteries; seventeen stations use the single-phase system and four stations the two-phase system, the combined rating of these twenty-one stations being 48,872 kw; 285 stations (172,292 kw) use the three-phase system, and fifty-seven stations (157,330 kw) use the combined alternating-current and direct-current system. The three-phase stations have lately shown the greatest increase, both with respect to their number and to their rating. Six hundred and fifty-two stations (44,275 kw aggregate capacities) have a generating rating of up to 250 kw each; seventy-eight stations (28,652 kw) have a rating of from 251 to 500 kw; fifty-one stations (29,350 kw) have a rating of from 501 kw to 1000 kw; thirty-one stations (42,380 kw) have a rating of from 1000 kw to 2000 kw; nineteen stations (68,050 kw) have a rating of from 2000 kw to 5000 kw, and thirteen stations (215,150 kw) have a rating above 5000 kw. As to the source of power the following figures are given: 375 stations use water-power, 138 stations steam power, 104 stations gas power, ninety-six stations water and steam, sixty-three stations water and gas, twenty stations steam and gas, thirteen stations steam, water and gas. In 607 systems (60,000 kw) overhead wires are used; in 132 systems (144,000 kw) cables are used; in 235 systems (222,000 kw) both cables and overhead wires are used. Some details are also given concerning the distribution systems. It appears that in recent distribution systems the three-wire system with from 200 volts to 250 volts finds most favor.—*Elek. und Masch.* (Vienna), Feb. 16, 1913.

Electrical Progress in China.—A long editorial discussion of the electrical advances taking place in Shanghai. The new Riverside power station is designed to accommodate a plant of 14,000-kw rating and the first instalment amounts to 4000 kw, but it has already been decided to install two more 5000-kw turbo-alternators. In order to advertise electricity the station will use "everything electrical," and it pays much attention just now to electric vehicles. Electric radiators are being readily adopted by Chinese consumers. The total connections of electric heaters and cookers in Shanghai now aggregate over 500 kw. A number of cotton mills are being electrified. Attention is called to the fact that German firms are securing the bulk of this work.—London *Elec. Review*, Feb. 28, 1913.

Wages in British Central Stations.—J. S. AINSWORTH.—In reply to an inquiry as to wages and vacations in British central stations, forty-seven stations send replies concerning maximum and minimum salary, average hours per week of charge engineers and switchboard engineers, also as to Sunday and vacation arrangement and emergency arrangement. The results are given in form of three tables.—London *Elec. Review*, Feb. 28, 1913.

Charging Storage Batteries.—A note on a recent British patent (No. 5434, 1912) of K. von Dreger. To minimize the loss in the series resistor generally used in charging small accumulators from lighting mains, the cells to be charged are connected in parallel with a large storage battery through series resistors. This storage battery is permanently in series with the mains.—London *Elec. Eng'ing*, Feb. 20, 1913.

Alternating-Current Switchboards.—C. H. SANDERSON.—This continuation of his illustrated serial on switchboards for alternating-current stations deals with remote mechanically controlled switchboards, their advantages, applications and types.—*Elec. Jour.*, March, 1913.

Wires, Wiring and Conduits

Cables for Shafts in Mines.—E. KILBURN SCOTT.—In an illustrated paper read before the Association of Mining Electrical Engineers in London the author recommends that high-tension aluminum cables be used in mine shafts; that armoring should be dispensed with on shaft cables, a return path for current being provided by metal work already in the shaft or by steel ropes specially suspended to serve this purpose; that siliceous tire rubber be employed in place of steel to provide mechanical protection on cables exposed to moisture and hard wear, and that split telegraph poles be used in place of the sawn casing hitherto used when cables have been inclosed.—London *Elec. Review*, Feb. 28, 1913.

Electrophysics and Magnetism

Vacuum Tube Discharge in a Magnetic Field.—N. A. KENT AND R. M. FRYE.—An abstract of an American Physical Society paper. Although many have studied vacuum-tube discharge in a magnetic field, no investigator has fully identified the resulting spectrum and classified the effects obtained upon the creation of the field. The writers have found that the decrease of the effective cross-section of the tube and the sand-blast action of the ions deflected against the glass—both caused by the magnetic field—result in the production of one or more of the following classes of spectra: (1) Those of impurities in the tube;

examples, hydrogen appearing in an argon tube and argon in a nitrogen tube. (2) Those of dissociation products of the original gas; example, the oxygen spectrum appearing in a carbon-monoxide tube. (3) Those of dissociation products of the glass; example, sodium and oxygen lines appearing in the spectra given by many tubes when in the field. The case of nitrogen and argon above mentioned is of special interest, as some of the lines of the blue spectrum of argon persist for at least ten minutes after the magnetic field is removed, and the reappearance of the band spectrum of nitrogen is gradual. This is a unique phenomenon.—*Phys. Rev.*, March, 1913.

Effect of Magnetization on Thermal Conductivity.—N. F. Smith.—An abstract of an American Physical Society paper. Contradictory results have been obtained by other observers. The present investigation has been confined thus far to a determination of the change produced in the thermal conductivity of iron by a longitudinal field. Observations have been made on metallic tubes 3/8 in. in diameter and about 3 ft. in total length. The iron tube and a comparison tube of brass were mounted side by side. One end of each of these tubes was maintained at a constant temperature of from 200 deg. to 225 deg. The two tubes were surrounded by similar solenoids, connected in series. The coil surrounding the comparison tube was wound non-inductively, while the winding of the other could be changed from non-inductive to inductive by a commutator. By a suitable arrangement of thermocouples two points of equal temperature were determined in the two tubes, while there was a non-inductive current in each coil. The magnetic field was then applied to the iron tube by shifting the commutator, and after time had been given for temperature conditions again to become steady the point of equal temperature in this tube was again determined. Fields up to 163 c.g.s. units were employed. The sensitiveness of the apparatus was such that a change of conductivity of 0.1 per cent could have been detected with certainty, yet in no case was an effect as great as this observed.—*Phys. Review*, March, 1913.

Units, Measurements and Instruments

Damped Moving-Magnet Galvanometer.—C. Féry.—In all commercial galvanometers with moving magnets the coil encircles the two poles of the magnet so that the interior diameter of the coil must have at least the length of the moving magnet. If, on the other hand, only one of the poles is subjected to the action of the coil, it is possible to make the internal diameter of the coil very small. This results in an increase of the counter emf due to a displacemen of this pole and to a decrease of the resistance of the wire of the coil. In consequence of this such strong currents are produced on short-circuit in the coil during a displacement of the magnet that an important damping effect is obtained. This condition can be realized by placing each pole of the suspended magnet between two pairs of

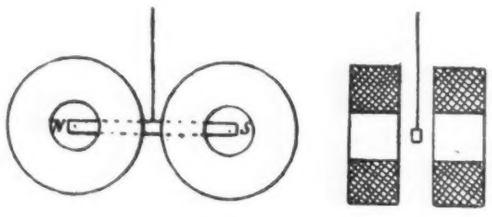


FIG. 1—MAGNET SUSPENDED BETWEEN COILS

coils near enough to constitute a single solenoid, as shown in Fig. 1, while Fig. 2 shows an astatic arrangement made up of the combination of identical bars joined together in twos, poles of the same sign being connected together. A testing galvanometer of this kind gave a deflection of 1 mm on a scale at a distance of 1 m for a current of 0.0000000008 amp. Each of the four coils has an external diameter of 12 mm and has 160 turns of wire of 0.5 mm. The resistance of the four coils in series is only 2 ohms. The duration of oscillation is fifteen seconds. The author expects to increase the sensibility still further by using a magnetic

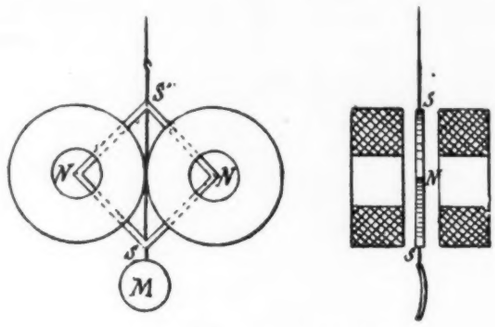


FIG. 2—AN ASTATIC ARRANGEMENT

casing and a suspension wire of quartz.—*Comptes Rendus*, Vol. CLV, page 1008; abstracted in *La Revue Elec.*, Feb. 21, 1913.

Micropyrometer.—G. K. Burgess.—An abstract of an American Physical Society paper. A small incandescent lamp is mounted within the Huyghens eyepiece of an ordinary microscope, which is then used as a Morse or Holborn-Kurlbaum pyrometer. Combined with a suitable furnace, such as platinum or other metallic strip heated electrically in vacuo or in a suitable gas such as hydrogen, melting points and emissivities of minute specimens (0.01 to 0.001 milligram or less) are readily observed. The apparatus is most conveniently calibrated empirically in terms of known melting points. It is being used for measurements on the rare refractory elements.—*Phys. Rev.*, March, 1913.

Comparison of Small Electrostatic Capacities.—J. C. Hubbard and H. F. Stimson.—An abstract of an American Physical Society paper. The electrostatic capacities of small bodies such as lead wires, binding posts, electrometers, small spheres or the change in capacity when two such bodies are joined, as when a lead wire is connected to a sphere, are compared by the method of divided charge with the capacity of a straight wire used as a standard. The instrument making these experiments possible is a gold-leaf electroscope of constant capacity. The method is especially applicable for measuring the capacities of bodies used in oscillation and ionization experiments.—*Phys. Rev.*, March, 1913

Telegraphy, Telephony and Instruments

Sounder in Submarine Telegraphy.—E. Raymond-Barker.—An illustrated article on John Gott's new principle of telegraph working, which enables the ordinary Morse, with its attendant automatic-translation facilities, to be worked on long submarine cables. The consequent close succession of signals, whether dots or dashes, of alternate + and — polarity, not only tends, during the progress of a letter or of a word, to keep a cable in an electrically neutral condition but also discourages distortion. While complimenting highly Scott's achievement the author points out that cable Morse telegraphy is not entirely new and gives an outline of the achievements of Pierre Picard. Picard sought to arrive at absolute sign alternation, combined with equality in the strength and duration of actual electrical charges, and this without any reference to the duration of an actual signal—that is to say, to the duration of the interval between the first impulse of a given sign and the following impulse of opposite sign. What differentiates Picard's principle from all others employed or tried up to his time has been his absolute abandonment of any idea of bringing back the electrical condition of the cable to a neutral condition after the application of each

charge. Picard has brought about that each transmitted impulse finds the cable in a symmetrically neutral electrical condition. In other words a + charge finds the cable influenced by a — charge of known value; a — charge finds in the cable a + charge equal to the preceding — charge

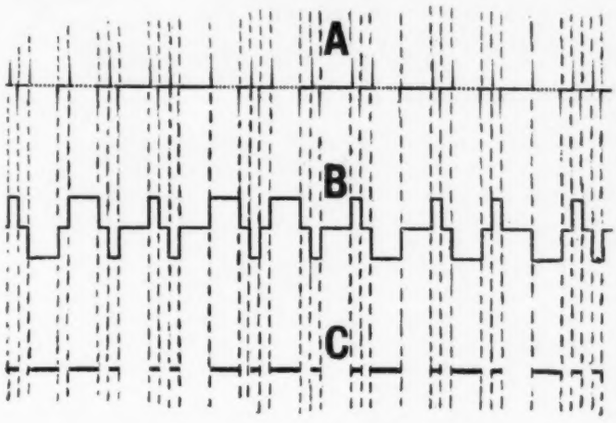


FIG. 3—PICARD AND GOTT TRANSMISSION PRINCIPLES COMPARED

and so on. Fig. 3 compares the Picard and the Gott transmission principles, and shows the word "Picard" in conventional graphs illustrative of the two principles, and in corresponding Morse. The Picard system is illustrated in *A*, the Gott system in *B*. Fig. 4 shows the master device of Pierre Picard, applicable to hand Morse, to Wheatstone automatic, to the Hughes or to the Baudot. In the illustration a simple cable Morse circuit is shown. Continuous lines represent main circuit, interrupted lines the local circuits; R_1 and R_2 are two polarized relays; $L B_1$, and $L B_2$ are local batteries. Owing to the presence of the local condenser $L C$ any depression of key k causes a momentary "kick" of relay tongue T_2 up against its stop contact on the + pole of the sending battery $S B_2$. Again, each time K comes to rest after each dot or dash the relay tongue T_1 makes a momentary contact against its stop contact on the — pole of $S B_1$. During the interval between the two-relay tongue kicks caused respectively by the depression and the raising of K, the sending end of the cable remains insulated on the electrically connected tongues T_1 and T_2 at rest. A graphic presentment of the working of the momentary + and — impulses is shown by *A* in the first diagram, which does not pretend to represent the real electrical conditions in the cable. At the receiving end of the line is $S C R$, a suspended-coil relay specially designed by Picard. The coil has no self-retractive force, but is absolutely free to respond, in its movements, only to cable impulses. Between the "relay" and earth is the receiving condenser $R C$. It will be seen that in Picard's system + and — momentary impulses cancel out, whether in a signal, a letter, a word

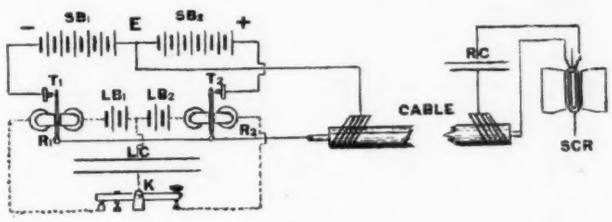


FIG. 4—PICARD'S MASTER DEVICE

or 1000 words. The Gott system of transmission, illustrated in *B*, if subjected to similar analytical treatment, gives interesting results, showing a certain + percentage of overcharge in some cases and a — percentage in others, but balancing out very evenly on the whole.—London *Elec. Review*, Feb. 28, 1913.

Book Review

AN EXPENSIVE EXPERIMENT. The Hydroelectric Power Commission of Ontario. By Reginald Pelham Bolton. New York: Baker & Taylor Company. 281 pages, illus. Price, $1.25.

The story contained in this book, which covers the establishment and operation of the Ontario transmission scheme, would be interesting at any time. Making its appearance at a time when the State of New York is considering the adoption of the scheme tried by the Province of Ontario, it is doubly interesting and instructive. The author has evidently spent considerable time in assembling and presenting information not easily obtainable which relates to the workings of a governmental undertaking after the general lines of which it is intended that the New York scheme is to be patterned. He claims that such schemes as these, while appearing under the guise of conservation or other beneficial activities, are in reality proposed for political ends only, and he anticipates that an exposition of their fallacies will not be well received, to put it mildly, in certain quarters. The strangest part of the situation, as set forth, is the small desire apparently felt by the inhabitants of the progressive Canadian Province in which the experiment is being tried to ascertain for themselves the whole truth, instead of accepting comfortably and somewhat blindly the statements issued by those in responsible charge.

Considering more particularly the Canadian experiment, the author makes it appear that the political bait which has been dangled before the eyes of taxpayers is the very beautiful theory that everyone, no matter how situated, would share in the benefits of having an unlimited supply of electricity brought to his door at cost. He argues that the theory does not work out very well in practice, and that sooner or later the taxpayers will realize that they have financially backed and assumed responsibility for a project which apparently supplies energy to a few of the inhabitants at less than cost while others will be obliged to make up the deficit. It has been denied by the promoters that any increased taxation will result from these operations. But the author maintains that this is inconceivable when it is considered that several of the activities embraced in the experiment have been carried on at the expense of the Province as a whole; for instance, the purchasing of materials, the canvassing of prospective motor users and the free engineering which has been done for some of the cities and towns served.

When a private company in the ordinary course of events enters the field to supply conveniences to a community it is taxed and bears a portion of the expense of that community and thus proportionately reduces the taxes paid by others. The service supplied, being a convenience and not a necessity, is not used by all and is paid for only by those using it. On the other hand, no taxes are paid on equipment used in the Canadian experiment for furnishing similar service to comparatively few users. Mr. Bolton draws attention to the light that is beginning to dawn in some of the cities using the energy, such as Berlin, Ontario, where requests have recently been made that the apparent book profits shall be used toward the reduction of general taxation in that city. These requests, it seems, have not been granted.

It is understood that the material included in the book formed a large portion of the minority report of the committee of the New York Legislature on the hydroelectric system of Ontario before which Mr. Bolton recently gave testimony to show that the system is not operating so successfully as claimed by those in charge. The book will be read with much interest both by those who agree with the author's presentation and by those who do not.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Socket Extension for Unskirted-Base Lamps

The lamp manufacturers are now furnishing the 60-watt tungsten lamp with unskirted medium screw base. The distance from the base contact to the center of the filament has thus been shortened approximately an inch and the former proper relation between filament and reflector accordingly destroyed.

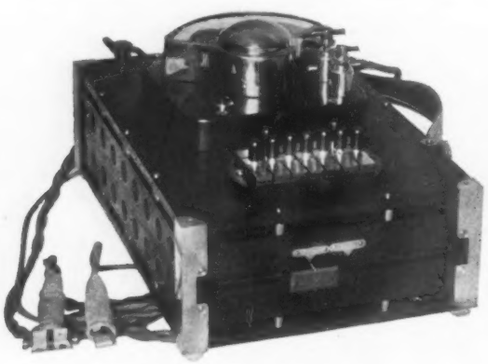
SOCKET EXTENSION FOR TUNGSTON LAMP

A socket extension made by the Benjamin Electric Manufacturing Company, Chicago, meets this condition by lengthening the sockets enough to overcome the defect. The new type of lamps can thus be used and proper lighting results obtained without change of reflector. Changes from a larger to a smaller size lamp can also be made by means of the same device.

Meter-Testing Set

A meter-testing set, known as the "Knopp set," has been placed on the market by the Western Electro-Mechanical Works, Oakland, Cal. The apparatus, which weighs complete only 8 lb., consists of a light box holding the resistor, upon which is mounted an indicator which shows the watts applied to the meter being tested and also indicates the current and line voltage during the test. A regulating slide is provided for holding the power supplied at a predetermined value.

The test set is used in such a manner as to do away with all computation for ascertaining the accuracy of the meter. The tester applies to the meter values of watts, which are numerically decimal multiples of the watt-hour calibrating constant, K, of the meter, thus causing the meter, if correct, to complete a certain number of revolutions in one one-hundredth of an hour. This time interval is measured with a special stop-watch which makes one revolution in one one-hundredth of an hour and has a decimally divided scale so that it will read in millihours and tenths thereof.



METER-TESTING SET

If the meter being tested is incorrect, the watch will show at once the correction factor of the meter; for instance, if the watch has passed through 104 divisions before the meter has completed the allotted number of revolutions, the meter has a correction factor of 1.04, or is approximately 4 per cent slow.

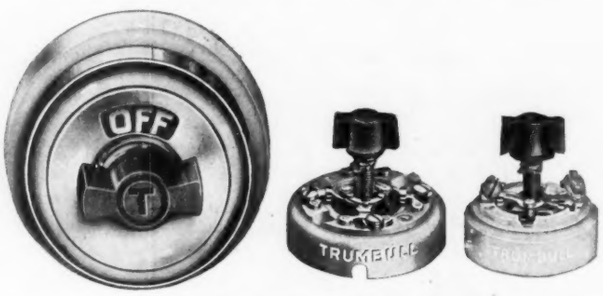
The simple rule for testing is to apply a multiple of $(100 \times K)$ watts to the meter. For a load of one hundred times K one revolution is counted; for two hundred times K two revolutions, and so on.

Circular Snap Switches

The Trumbull Electric Manufacturing Company, Plainville, Conn., has brought out a line of circular snap switches, some of which are illustrated herewith. They are especially notable on account of the smooth action and the strong and rigid construction.

The best movement in this type of switches is obtained by the use of an eccentric. In these switches use is made of a large release plate and two bearings, one at each end, so that the eccentric can move the release plate easily and smoothly. The ratchet plate is secured in a larger plate, which is recessed into the porcelain base and secured by means of a brass bushing, the latter in turn forming a long and rigid bearing for the spindle. The locking and releasing parts are made of hardened steel. The wire spring is long and flexible and the blades have a large contact surface. The dials are fastened directly to the spindle, thereby obviating the tendency to get loose which is said to show itself with dials fastened to the blade mechanism. In multiple-pole switches the pair of contact plates are mounted in different planes, increasing the break distance and also the factor of safety.

FIGS. 1 TO 3—SINGLE AND MULTI-POLE SNAP SWITCHES



FIGS. 4 TO 6—CIRCULAR SNAP SWITCHES

The terminals in all but the smallest sizes are flat so that the screws are operated directly from the front, which makes installation easier especially near a corner.

"Triple-Heat" Electric Iron

An electric iron which is of unusual interest on account of the flexibility of heat intensity and the localization of the heat has recently been patented and placed on the market by the Waage Electric Company, 674 West Madison Street, Chicago. In fact, with the connections available four different heats can be obtained, but by the manufacturer the iron is called the "triple-heat" flatiron.

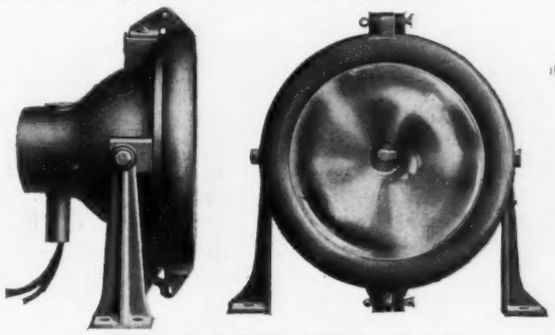
"TRIPLE-HEAT" FLATIRON

From the illustration it will be noted that the switch block is marked on one side "hot"; on the other side it is marked "medium." The regulation of the heat is accomplished through attaching this block in different ways to the plugs. The heating element consists of mica leaves around which the heating coils are wound. each one of the latter being connected to isolated terminals, which in turn are connected to the plugs. Through the switching mechanism more heat can also be applied to either the front or the rear of the iron as may be desired.

The two extensions at the rear of the iron take the place of a stand, it being considered easier to tip an iron back than to lift it to a stand.

Lamp Giving Fog-Penetrating Light

It has been recognized in lighthouse and marine work that a golden-yellow light will penetrate fog and mist to a greater degree than ordinary white light. A lamp for such service made by the Esterline Company, Lafayette, Ind., has recently been submitted to extensive tests on the Great Lakes and on the seacoast. The glass used in these lamps possesses a greenish-yellow color, which is said to give to the light a remarkable penetrative power. In a similar lamp placed on the market by the same company for electric railways and steam and mining locomotives a new feature is the reflector, which consists of a molded plate-glass parabola, ground accurately to size and shape and polished and silvered like a plate mirror. On account of the great efficiency of the reflector, the heat as well as the light is reflected so that the front glass will not remain coated with snow or ice in even the coldest weather.

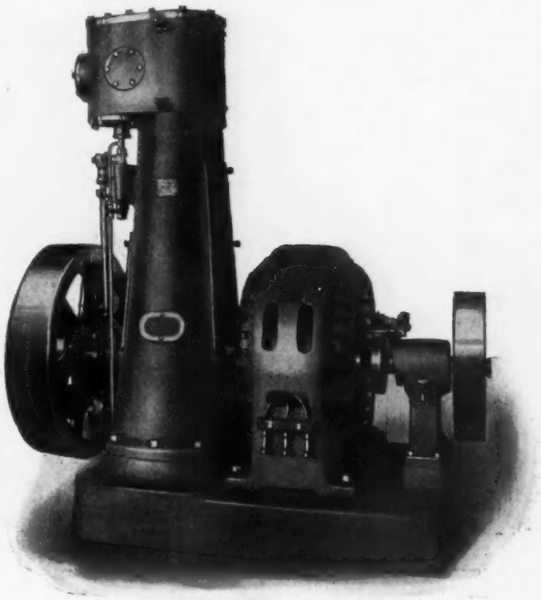


HEADLAMP FOR LOCOMOTIVES AND CARS

A standard spherical incandescent bulb is used with a standard Edison base. The front of the lamp is hinged to the top and pressed tight against a gasket, thereby rendering the lamp practically water-tight and dust-tight. The illustration shows a hood-type lamp designed for mounting on top of a car. In the dash-type a part of the lamp is recessed into the surface on which it is mounted.

Alternating-Current Direct-Connected Generating Set

A line of alternating-current generator sets directly connected to steam or gas engines is now manufactured by Engberg's Electric & Mechanical Works, St. Joseph, Mich.



ALTERNATING-CURRENT DIRECT-CONNECTED GENERATING SET

Standard sets are made in sizes up to 70 kva for 240, 480, 600, 1200 and 2400 volts and for several different speeds. The engine is said to be extremely simple and compact with full accessibility of all working parts. The generator is designed to have considerably lower temperature rise than is provided in the A. I. E. E. Standardization Rules. It will carry a continuous overload of 20 per cent and a momentary overload of 60 per cent. The ventilating system is said to be exceptionally effective, much open space being provided in the armature core and field coils so as to allow free circulation. The design is such that excitation can be caused by 125-volt direct current.

Panelboard Lightning Arresters

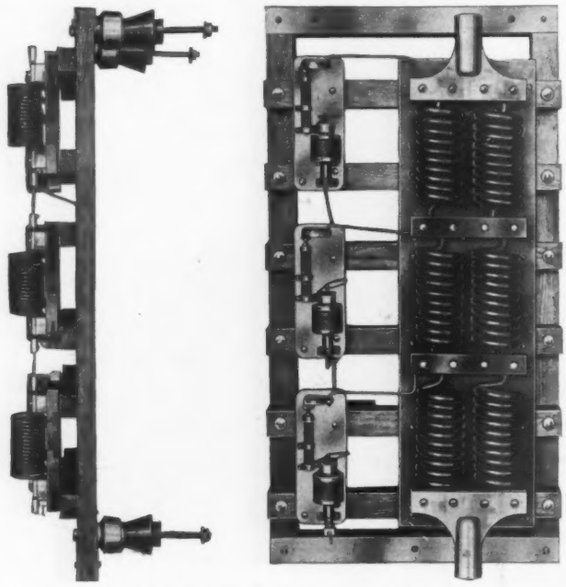
For the protection of individual machines and apparatus, particularly against "leakage" in the ordinary arresters in case of severe lightning disturbances, the Electric Service Supplies Company, Philadelphia, has designed and placed on the market a line of panelboard lightning arresters for both alternating-current and direct-current service.

These arresters are said to take care of the leakage by interposing choke coils between the line and the apparatus to be protected and by connecting lightning-arrester units ahead of these coils. Any leakage passing the first arrester unit, for instance in a triple board, must pass through three choke coils and by two additional arrester units before it can get into the apparatus.

With only a single choke coil and a single arrester unit, and assuming that 90 per cent of the discharge goes to ground through the arrester, it is seen that 10 per cent will be left to enter the apparatus. If an additional choke coil and a second arrester unit be placed back of the first set, and assuming that the second unit takes 90 per cent of the leakage, only 1 per cent of the original charge remains to flow into the apparatus. Similarly with a third choke coil and a third arrester unit, only 0.1 per cent of the original charge will be left to enter the apparatus to be protected. In other words, by the addition of extra arrester units and

extra choke coils, the protection to apparatus is said to be increased tenfold by a double panelboard, a hundredfold by a triple panelboard, and a thousandfold by a quadruple board.

The boards are regularly built in station type, mounted on heavy impregnated oak framework and are complete with



PANELBOARD LIGHTNING ARRESTER

insulators for attaching to any suitable support. They are designed for railway systems for emfs up to 6600 volts alternating current and 2500 volts direct current and for arc circuits operating at pressures up to 6000 volts direct current or alternating current. They are built for any current within these ranges of voltages.

Semi-Indirect Store Lighting

A lighting installation which is unusually attractive and efficient was recently completed for the Einstein-Wolff

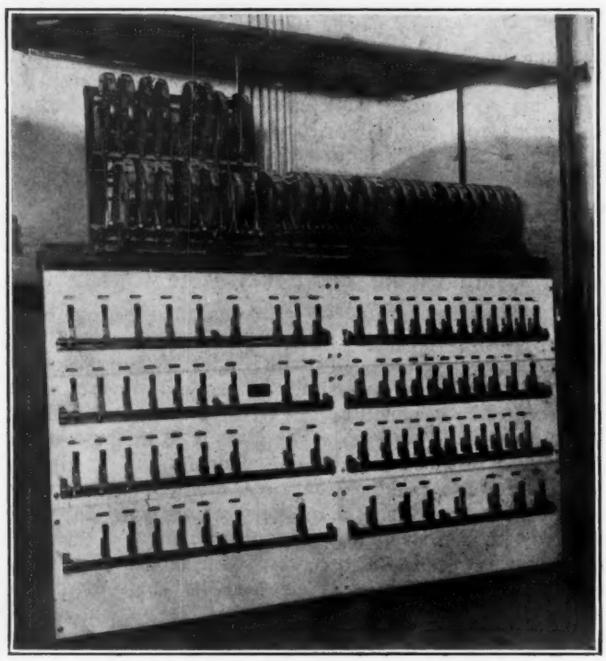
SEMI-INDIRECT LIGHTING IN STORE

Company, New York. The goods carried by this company consist mainly of imported laces and embroideries, requiring a strong soft light without glare.

The first floor, a view of which is shown in the accompanying illustration, is lighted by forty fixtures, each equipped with four 100-watt tungsten lamps. The glass dishes of so-called Doric glassware were designed and made by the Lighting Studios Company, 16 East Thirty-third Street, New York. They are 28 in. in diameter and are suspended by three 6-ft. chains. The metal parts are finished in French gray silver. It is said that an illumination of approximately 10 foot-candles is obtained at the working plane. The installation was made by the Goodwin & Kintz Company, 25 West Broadway, New York.

"Dead-Front" Theater Switchboard

At the Palace Theater, New York, which is now nearing completion, there has been installed a so-called "dead-front" switchboard. It is constructed in two separate sections, the front section being of marble, on which are mounted the operating handles and rods, all of which are insulated from the rear section, which carries the live-contact parts. The rear section is made up of busbars feeding energy through fuses and switches from the various circuits of the magazine panel. The magazine panel is made up in sectional panels containing busbars and link fuses, and



"DEAD-FRONT" SWITCHBOARD IN THEATER

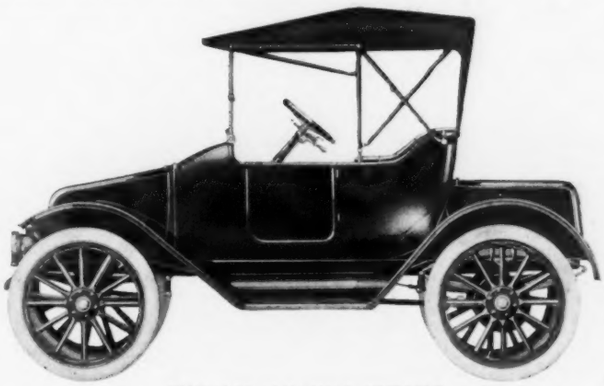
these separate panels are contained in a steel cabinet mounted on the wall directly back of the switchboard, with channel arrangements provided to carry the wires from the switchboard to the magazine without interfering with the open space back of the board. The dimmer equipment is mounted on top of the board with the operating handles extending down to bring them in reach.

Three separate circuits are controlled from the board. One of these furnishes energy for the auditorium, one for the stage lighting and one for the arc lighting. This arrangement prevents the possibility of trouble on the stage interfering with the lighting in the auditorium and adds to the element of safety. A main switch on the board controls each separate feeder, and the entire lighting in the house or on the stage can be thrown on or off at one time, or with the separate switches which have been provided for the separate sections. For the foot-lighting and border lighting there are red, white, blue and amber lamps, and the board is arranged with a separate switch for each color, and in addition a master switch controlling each color on the entire stage.

The board was furnished by the Worcester Electric & Manufacturing Company, Worcester, Mass., through the Empire Engineering & Supply Company, New York, and was erected by the Van Wagoner Linn Construction Company, New York.

Electric Roadster

The new roadster made by the Baker Motor Vehicle Company, Cleveland, Ohio, is said to contain the latest and most modern features in automobile design. It is equipped



ELECTRIC PLEASURE VEHICLE

with a thirty-two-cell "Exide" battery, a complete set of electric head and tail lamps, a Weston volt-ammeter and a shaft odometer. It has a wheelbase of 88 in. and is equipped with 34-in. by 4-in. pneumatic tires. It has wheel or lever steer, open mohair top with side curtains and metal fenders skirted to a chassis frame.

Horn-Type Disconnecting Switch for Pole-Top Mounting

The disconnecting switch herewith illustrated has been designed by Mr. J. R. Townsend, 700 East Sixty-first Street

FIG. 1—SWITCH IN CLOSED POSITION

North, Portland, Ore. The main contacts of the switch consist of a rotating disk mounted in a yoke so that a set of spring clips on the switch arm when forced over the disk cause it to rotate, giving a grinding-in contact. A looped stationary horn acts as a guide for the main contacts and insures the arc being drawn from the horn under all conditions. A small grooved trolley wheel mounted on a flat spring is the auxiliary contact and is said to prevent any arcing from the main contacts, the circuit being finally broken between the movable horn and the grooved trolley, the arc climbing up the stationary horn until sufficiently high to cause it to rupture.

Fig. 1 shows a three-pole, 60,000-volt switch in closed position, with sleet shields in place for protection of con-

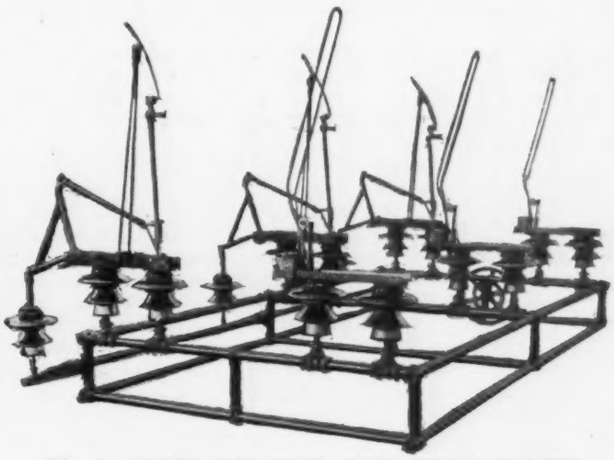


FIG. 2—SWITCH OPEN WITH SLEET SHIELDS REMOVED

tacts. The grooved wheel operates through an angle of 180 deg. from open to closed position and is provided with limit stops. Fig. 2 shows the same switch from the opposite side in the open position with the sleet shields removed. A switch installed on a 60,000-volt line of an interurban electric railway system is shown in Fig. 3. On this line nine such switches are in use.

The entire switch is mounted on a rigid pipe framework and is assembled completely around four poles on the

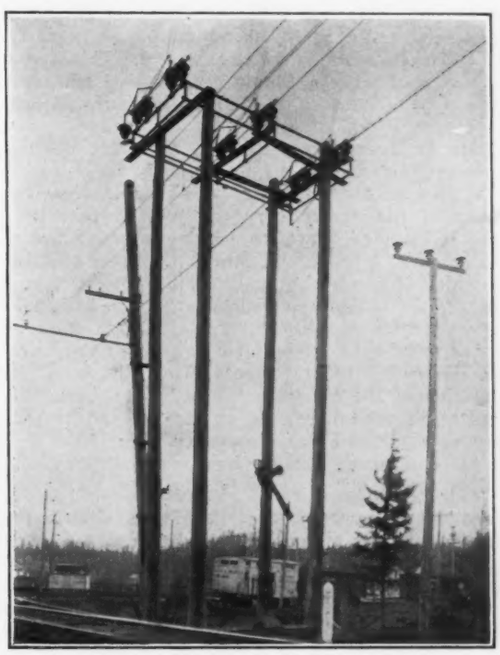


FIG. 3—HORN-TYPE DISCONNECTIG SWITCH

ground and then hoisted into position by block and tackle.

Oscillograph tests made on the opening charging current characteristics of this switch are said to have shown less tendency to set up high-frequency currents, with the resultant increased voltage, than is ordinarily encountered with the best type of oil switches.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Personnel of New Allis-Chalmers Manufacturing Company.—As a part of the plan for reorganizing the Allis-Chalmers Company, articles of incorporation for the Allis-Chalmers Manufacturing Company, with a capital stock of $42,500,000, were filed in Delaware on March 15. Of the new stock $16,500,000 is preferred and $26,000,000 common. The incorporators of the new company held an organization meeting early this week, at which directors and officers were elected. Voting trustees, who will manage the company for some time to come, were also chosen by the reorganization committee. Directors for the Allis-Chalmers Manufacturing Company were chosen as follows: John H. McClement, chairman of board of directors; O. H. Falk, president of the company; O. C. Fuller, J. D. Mortimer, G. G. Pabst and Frederick Vogel, Jr., all of Milwaukee; Max Pam and F. O. Wetmore, of Chicago; A. W. Butler, C. W. Cox, O. L. Gubelman, R. G. Hutchins, Jr., Arthur Coppell and W. C. Potter, of New York, and J. P. Winchester, of Wilmington, Del. The executive committee, all of whose members are Milwaukee men, is as follows: Frederick Vogel, Jr., chairman; O. H. Falk, O. C. Fuller, J. D. Mortimer and G. G. Pabst. Active operation of the manufacturing plants will be started under the direction of five voting trustees as soon as the final steps in the reorganization are taken. This will probably be not later than May 1. Sale of the Illinois property is to take place on April 8, as stated in these columns last week, and confirmation of the sale will be given shortly afterward. A meeting of the reorganization committee will be held in the near future to determine the dates for calling the balance of the assessments on the old preferred and common stocks. There is still a payment of $8 per share on the preferred and $4 on the common stock to be made. The Allis-Chalmers Company was incorporated in New Jersey in 1901, and by taking out the new charter in Delaware the incorporators of the new company effected a saving of over $5,000 in annual franchise taxes. The incorporation of the new company in Delaware is regarded as a further indication of the intention of large corporate interests to take charters elsewhere than in New Jersey, on account of the severe corporation laws recently enacted in the last-named State, to which reference was made in these columns Feb. 22 and March 1. From the list of officers which is given above, it will be noticed that the personnel of the company consists largely of Milwaukee men, as was forecast in these columns Jan. 11. Many of these men are prominent in the civic and financial affairs of that city. According to statements made this week to a representative of the *Electrical World* by a member of the reorganization committee, the operating headquarters of the new company will be at Milwaukee. The New York office will be continued, chiefly for financial purposes, board meetings, etc.

Does Not Expect Large Profits in Contracting This Year.—A member of one of the best known electrical contracting and consulting engineering firms in the country, with headquarters in New York, in discussing conditions in the electrical industry said this week that he feels that the current year will not be an especially good one for electrical contractors as a whole, from the standpoint of profits. "The field is greatly overcrowded," he said, "and of course, with active competition, price-cutting and small profits are the consequence. Raw materials are higher also. There is a great deal of new work going on here in the East, but the individual jobs are rather small and consist chiefly of extensions and remodeling of present installations. The supply dealers are very busy just now. As far as our own firm is concerned, there is nothing to complain of. We are in a more fortunate position than most contractors, for we have a standing contract with a very large public-service corporation to do all of its installation work, of which there is always a great deal, and in this way we have something on hand at all times to keep our force engaged. Then we pay a great deal of attention to our soliciting methods and utilize modern ideas in conducting all of our affairs. Many contractors are lax, exceedingly so, in their business methods. At present we are at work on the complete electrical equipment for a number of the largest office buildings, department stores, railroad stations and banks in the country, particularly in the Middle West. There is plenty of business as far as we are concerned. The prospects are good, but in the majority of instances the profits for the year do not loom up very large, as I see conditions at this time."

Electrification Plans of New Haven Railroad.—An initial order for equipment of various kinds, amounting to about $2,000,000, was placed this week by the New York, New Haven & Hartford Railroad Company. The order for electrical equipment was placed with the Westinghouse Electric & Manufacturing Company through its New Haven office. The electrical equipment includes twenty-three multiple-unit motors, twenty-two multiple-unit trailers and twelve electric locomotives. Other equipment ordered includes eighty-five steam road engines, twenty-five switching engines, eleven steel dining cars, fifty steel vestibuled coaches, twenty-five steel postal cars and fifty steel baggage cars. The purchase is designed to equip the through service of the Shore Line Route with all-steel cars. Another order, to be placed shortly, will cover complete equipment for all-steel cars for the New York-Boston service. Preliminary plans are being made in connection with forthcoming electrification by the New York, New Haven & Hartford Railroad of the main line between Boston and Providence, although it has not yet been definitely announced whether the New Haven-Providence or the Boston-Providence section will be first equipped. The company will four-track the road for the entire distance. Electrification and grade-crossing abolition will be important parts of the work. At East Junction, R. I., through trains from Boston to New York will be operated through a tunnel into Providence. Thirteen grade crossings are to be eliminated between Readville and East Junction, and it is expected that the detailed plans for the work will be completed by the coming fall.

Steam Engine Manufacturers to Enter Oil-Engine Field.—While no details will be given out at this time and the names of the interested parties are withheld, it is learned that several well-known manufacturers of reciprocating engines, of long connection with the steam-engineering field, are carrying on negotiations with American representatives of a foreign Diesel-engine-building company, with a view to forming a company to manufacture crude-oil engines of the Diesel type. If present plans materialize, the proposed company will be a large one and will have strong financial support. The marine as well as the stationary type of engine will be built by the new company. Details of the plan will be available in about two weeks, according to statements made this week by a representative of one of the parties.

Good Business in Small Motors.—"Our sales of small motors, particularly our single-phase line, are much larger now than they were at this time last year," said A. W. Eckhoff, of the New York office of the Bell Electric Motor Company, this week. "We are doing a good business in all our other lines as well. The demand for our small motors for industrial purposes is very good, especially from the West and South. I think the prospects for good business during the rest of the year are very bright."

Improvements in Indianapolis.—A number of important additions to its system are being made by the Indianapolis Light & Heat Company. During the month of February the company purchased a 9000-amp-hr. "Exide" battery, which is to be installed in July and August and is to float on the system as an emergency installation only. A 12,500-kw horizontal-type Curtis turbine unit has been purchased from the General Electric Company for the Mill Street station of the Indianapolis company. Excavation for doubling the size of the Mill Street building was begun on March 11, preparatory to installing this turbine and 3000 additional boiler horse-power. The enlarged building will be of sufficient size to accommodate two additional 15,000-kw turbine sets and 5000 additional boiler horse-power. At the same station the company has just completed a sub-aqueous coal-storage bin. Details of the plans for this bin, which has a capacity of 30,000 tons, appeared in the *Electrical World* for Oct. 5, 1912, page 714. Requests for bids on a locomotive crane for handling the coal to and from the bin have been sent out by the company. A large quantity of underground feeders, together with considerable overhead construction, are being installed by the company this year. A contract for a thirty-thousand-dollar warehouse to be placed on Kentucky Avenue, Indianapolis, has been let by the company, and work on this is now in progress. All of the engineering in connection with the foregoing was done by Thomas A. Wynne, vice-president of the Indianapolis Light & Heat Company.

Chicago, Milwaukee & St. Paul Electrification Contract.—Henry F. Kroyer, secretary of the Montana Power Company, in a statement reviewing that company's affairs, sent this week to the stockholders, calls attention to the contracts made by the Great Falls Power Company and the Thompson Falls Power Company with the Chicago, Milwaukee & St. Paul Railway for supplying the latter with electrical energy to operate 450 miles of its main transcontinental line. A reference to this contract appeared in the *Electrical World*, Feb. 8, 1913. By these contracts, which cover a period of ninety-nine years and go into effect on or before Jan. 1, 1918, the railway company is obligated to take and pay for 20,000 kw of electrical energy and has taken options on additional energy to the amount of 30,000 kw. This option must be exercised one-half in five years and the other half in ten years, but not less than one-half of the amount under option must be taken, if any. The aggregate capacity of the plants of the Montana system is 104,000 hp. The estimated capacity of water-power sites owned by the Montana company, undeveloped and in course of development, is 243,000 hp, making a total capacity with the foregoing, developed and undeveloped, of 347,000 hp.

Detroit Insulated Wire Company's New Manufacturing Facilities.—At a recent meeting of the stockholders of the Detroit Insulated Wire Company E. E. Keller, the president, presented one of the most satisfactory reports in the history of the company. This showed that the successive annual increase in business during previous years had been largely increased in 1912, the increase in sales last year over those in 1911 being approximately 75 per cent. In view of the optimism that prevails as to the industrial outlook for the current year, the officials expect that the company's record for 1913 will be even better than that of 1912. Extensive additions have been made to the manufacturing facilities, including increased floor area and new machinery and equipment, which within the next thirty days will permit of a 50 per cent increase in the present output. The company is now manufacturing all sizes of solid and stranded rubber insulated wire, including the largest size cable, and has just completed more than a mile of 2,000,000-circ. mil cable for one of its customers.

Electric Furnace Manufacturers Are Busy.—The Pittsburgh Electric Furnace Company, Pittsburgh, Pa., is receiving estimates on iron and steel materials to be used in a 100-ton electric furnace which is to be erected in Arizona and will be used for reducing copper ore. Several electric furnaces were recently erected in Indiana by this company, which, in addition to the Arizona furnace mentioned above, is building five furnaces to be used for reducing silver ores. These will be installed at Bridgeport, Conn. The Electric Furnace Company, Alliance, Ohio, which builds the Baily electric furnace for heating bars, ingots and billets, has increased its capital stock from $50,000 to $100,000. A number of installations of its furnace in automobile works, drop-forging and other plants in various parts of the country are being made by this company.

Open Sales and Engineering Offices in Baltimore.—The Chesapeake Engineering & Equipment Corporation, which was organized a short time ago, has opened offices at 19 East Lombard Street, Baltimore, Md., and will sell electrical and steam apparatus and supplies, do engineering work and assist in financing and installing generating plants. The president is N. B. Hoskins, who was formerly connected with the General Electric and Westinghouse Electric & Manufacturing companies and with the Southern Engineering Corporation, and the secretary and treasurer is C. B. Hellman, who was also with the General Electric Company at one time. The company is representing several well-known manufacturers of steam and electrical equipment.

Equipment for New York Edison Company.—In addition to the 21,000-kva, 6600-volt, 25-cycle, three-phase horizontal turbo unit which it is to build for the New York Edison Company's Waterside Station No. 2, as stated in these columns March 1, the Westinghouse Electric & Manufacturing Company is to furnish to that company the following apparatus: one 3300-kva, one 1285-kva, one 3850-kva, six 500-kva and twenty-one 2000-kva, three-phase, air-blast transformers. Two 96-kw booster sets, consisting of one 150-hp direct-current motor and two 48-kw direct-current generators wound for 30 to 60 volts, together with a Westinghouse Le Blanc condenser and accessories to go with the turbine unit, are also included in the order.

Seek to Reopen Long Acre Case.—Upon application of the New York Edison Company, a writ of certiorari was issued this week by Justice Davis, of the New York Supreme Court, and served upon the Public Service Commission for the First New York District. This writ calls for a review of the commission's order of recent date, referred to in these columns March 8, authorizing the Long Acre Electric Light & Power Company, of New York, to issue $4,000,000 in bonds and $2,000,000 in stock and to begin construction of a power station to operate in New York.

Pennsylvania Railroad to Extend Electrification.—The directors of the Pennsylvania Railroad have authorized the electrification of the company's main line for suburban traffic out of Philadelphia to Paoli, a distance of 20 miles. This is in line with the plan of the company to change the motive power from steam to electricity on all of its branches within the city limits of Philadelphia. The cost of the work is estimated at $4,000,000. This, it is understood, covers only the track and electrification work, and not the power station or equipment changes.

Going Ahead with Cleveland Municipal Plant.—Following a court decision favorable to the city in a suit which had been brought to restrain the sale of $1,500,000 municipal electric light bonds, work on the erection of the generating plant for the city of Cleveland is to be rushed in the hope of being able to obtain service from the plant by Nov. 1, 1913. In trying the case the court took the view that the public had voted on the bonds, had known what it had voted for, and had shown by its vote that it was in favor of issuing them.

Power-Station Apparatus for Havana.—Among contracts recently closed by the Westinghouse Machine Company was one from the Havana Electric Railway Company, of Havana, Cuba. This called for about $500,000 worth of equipment, which included six turbine units, three condensers, several boiler-feed pumps and a quantity of power-station auxiliaries.

Will Enlarge Station at Connellsville, Pa.—Plans are being made by the West Penn Railways Company to make extensive additions to its generating station at Connellsville, Pa. Orders have been placed with the Westinghouse Machine Company for two 17,000-kva turbine units. About $500,000 is to be spent by the company on the improvements.

New Station for Cincinnati.—A four-million dollar generating station is to be built in Cincinnati by the Columbia Gas & Electric Company, according to unconfirmed reports.

Changes in Canadian Companies.—In accordance with a recent act of the Legislature, the Saraguay Electric & Water Company, of Montreal, has changed its name to the Montreal Public Service Corporation. The company has also acquired the Paul Electric Light & Power Company, the Dominion Light & Power Company and the distribution system of the Canadian Light & Power Company. As a result of these changes, the distribution of energy in Montreal by the Roberts interests will be done under the name of the Montreal Public Service Corporation. The president of the latter is E. A. Robert, the secretary and treasurer H. R. Mallison, and the chief engineer and operating manager K. B. Thornton. The Montreal Tramways & Power Company, Ltd., of Montreal, of which E. A. Robert is president, is the holding company for the Montreal Public Service Corporation, the Montreal Tramways Company and the Canadian Light & Power Corporation. The latter, which supplies the energy for the Montreal Public Service Corporation, has a 22,500-hp hydroelectric development on the St. Lawrence River, near St. Timothé, Que. This is capable of an ultimate development of 75,000 hp. The delivery of energy from this station was begun in September, 1911.

Large Gains by Otis Elevator Company in 1912.—The pamphlet report of the Otis Elevator Company for the year ended Dec. 31, 1912, issued this week, shows net earnings, after deducting all charges for interest, patent expenses and renewals and repairs for maintenance of plant, of $1,282,195, as compared with $1,082,116 in 1911. After payment of $389,808 in preferred dividends there remained a balance of $892,387, which is equivalent to 14 per cent on $6,375,000 common stock, before charging out depreciation, as compared with 10.9 per cent on the same stock in the previous year. Common dividends amounted to $255,012, leaving $637,395, from which was deducted $100,000 for the pension fund and $298,868 for depreciation. After these deductions there remained a surplus of $288,507, which compares with $110,110 in 1911. W. D. Baldwin, president of the company, said in part: "Your company during the past year has shared in the general industrial prosperity of the country, and a volume of business was done in excess of any previous year and a larger amount of unfinished work carried forward for completion into the year 1913."

A New Canadian Company Formed.—The International Light & Power Company, Ltd., of Toronto, has been incorporated with $20,000,000 capital stock. Its charter authorizes it "to underwrite, subscribe for, purchase or otherwise acquire and hold, either as principal or agent, the bonds or other securities of any incorporated company." It has been said that the new company will effect a rearrangement of the three subsidiary concerns of Henry L. Doherty & Company, the idea being to obtain a Canadian charter for the purpose of holding American companies and in this way avoid conflicts with American legislation pertaining to large corporate business. Representatives of Henry L. Doherty & Company said this week that there was no truth in the rumor.

Michigan State Telephone Company to Make Improvements.—At a meeting of the board of directors of the Michigan State Telephone Company at Detroit on March 13, improvements in the system that will entail the expenditure of $2,500,000 were approved. Most of this work will be done outside of Detroit and special attention will be given to the improvement of the long-distance lines, according to A. von Schlegell, general manager of the company. The acquisition of the Home Telephone plant has given the company an abundance of equipment in Detroit. Frank W. Blair, president of the Union Trust Company, and Emory W. Clark, president of the First National Bank, are two Detroit men who were added to the board at the meeting.

Elections at Central Illinois Public Service Meeting.—At a meeting of the stockholders of the Central Illinois Public Service Company held Feb. 26 at Mattoon, Ill., the following directors were elected: Samuel Insull, chairman; A. J. Authenreith, R. B. Donnelly, George W. Hamilton, Martin J. Insull, F. S. Peabody and Marshall E. Sampsell. The board of directors elected the following officers: President, Marshall E. Sampsell; vice-president, F. S. Peabody; secretary and treasurer, R. B. Donnelly; assistant secretary, E. C. Beatty; assistant treasurer, Carl Cripe, and auditor, P. A. Erlach.

New Public Utility Company Formed in Colorado.—The Western Colorado Power Company, with a capital of $5,000,000, has been incorporated by D. E. Wilson, M. A. Lewis and H. B. Teller, attorneys, of Denver. The company will operate in La Plata, San Miguel, San Juan, Ouray, Montrose, Delta, Montezuma, Mesa and Dolores Counties, which are in the western and southwestern parts of the State. Construction work is to be started shortly, according to statements credited to Mr. Lewis, and energy supplied as soon as possible to the extensive agricultural districts in the sections named above.

To Merge Mississippi River Power Distributing Company.—The Suburban Electric Light & Power Company of St. Louis has recently changed its name to the Electric Company of Missouri. It has increased its capital stock from $750,000 to $3,000,000 and has been authorized to issue bonds to the amount of $1,750,000. With the proceeds of this bond issue it is proposed to purchase the Mississippi River Power Distributing Company and the small companies at Union, Pacific and Washington, Mo., which the Power Distributing company acquired recently, as noted in these columns Feb. 22.

Abandon Municipal Lighting System at Middleboro, Mass.—After twenty years of operation, municipal gas and electric lighting has been found inexpedient at Middleboro, Mass., and a committee has been appointed to enter into negotiations with the Brockton Electric Company for a supply of electrical energy. It is stated that the municipal plant has over $200,000 liabilities and that the loss last year on the gas plant alone was 10 per cent.

American Light & Traction Expanding.—At a special meeting of the American Light & Traction Company this week the stockholders voted to increase the common stock from $15,000,000 to $40,000,000. All the directors were re-elected at the annual meeting.

Completes Line to Nashville Substation.—The Tennessee Power Company has finished stringing copper and guard wire between Murfreesboro and the 110,000-volt substation in Nashville.

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	Mch. 12	Mch. 19
Allis-Chalmers, t.r., 3d pd...	$15,501,800	.....	.....	3¼	3⅛
Allis-Chal., pf., t.r., 3d pd...	14,115,500	.....	.....	9	8
Amalgamated Copper.....	153,887,900	1½	Q	69⅜	68⅛
American Tel. & Tel.....	344,096,000	2	Q	132¼	131½
Electric Storage Battery, c.	16,074,425	1	Q	51	51
General Electric.....	101,203,500	2	Q	138	136
Mackay Cos., c.....	41,380,400	1½	Q	83*	81*
Mackay Cos., pf.....	50,000,000	1	Q	67⅜*	67⅜*
Western Union Tel.....	99,745,400	¾	Q	66⅛	66⅛
Westinghouse E. & M., c....	33,845,300	1	Q	68½	62
Westinghouse E. & M., pf...	3,998,700	1¾	Q	118*	117

*Last price quoted.

NEW YORK METAL MARKET PRICES.

	March 11		March 18	
	Bid.	Asked.	Bid.	Asked.
Copper:				
Standard, spot	14.37½	14.75	14.00	14.75
	£ s d		£ s d	
London, standard, spot	65 5 0		64 7 6	
Prime Lake	14.90	to 15.00	14.85	to 14.95
Electrolytic	14.85	to 14.95	14.85	to 14.95
Casting	14.70	to 14.80	14.65	to 14.75
Copper wire, base	16.00	to 16.25	16.00	to 16.25
Lead	4.35		4.35	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	8.25		8.25	
Spelter, spot	6.40	to 6.50	6.30	
Tin, spot	46.25		46.00	
Aluminum:				
Prompt delivery	25.50	to 26.00	26.50	to 26.75
Future	25.50	to 26.00	26.50	

OLD METALS.

Heavy copper and wire	13.62½	13.62½
Brass, heavy	9.00	9.00
Brass, light	7.75	7.75
Lead, heavy	4.15	4.15
Zinc, scrap	5.12½	5.12½

COPPER EXPORTS IN MARCH.

Total tons to March 19..... 21,423

Personal

Mr. Thomas Edwards has been appointed manager of the Malvern (Ark.) Electric Company.

Mr. Henry L. Doherty sailed for London on March 19. He will be away about three weeks.

Mr. Joseph K. Choate has been elected a vice-president of the J. G. White Management Corporation.

Mr. J. V. Smeaton has been appointed manager of the Bay Point Light & Water Company of Bay Point, Cal.

Mr. J. T. Bateman has been appointed superintendent of the Clarendon (Ark.) Electric Light & Ice Company.

Mr. C. N. Wiley has been appointed manager of the newly instituted central-station service at Ragland, Ala.

Mr. C. M. Brewer has been appointed local manager for the Western States Gas & Electric Company at Richmond, Cal.

Mr. F. E. Bunnell has been appointed superintendent of the Estes Park Electric Light & Power Company, Estes, Col.

Mr. I. W. Day has succeeded Mr. G. E. Matthies, formerly manager of the Seymour (Conn.) Electric Light Company.

Mr. Weldon Thompson has succeeded Mr. H. H. Bailey as superintendent of the Enterprise (Ala.) electric-lighting system.

Mr. F. A. Faust is manager for the Burbank (Cal.) Electric Light & Power Company, which recently began operation.

Mr. H. G. White has been appointed manager and superintendent of the municipal electric-lighting plant at Glendale, Ariz.

Mr. A. G. Sangster, for the last three years electrical superintendent of the Saskatoon (Sask.) municipal system, has resigned.

Mr. J. A. Taylor has resigned as superintendent of the Weston (Ont.) municipal plant and has been succeeded by Mr. Robert Greer.

Mr. W. A. Watts has succeeded Mr. Thomas O'Rourke as new-business manager of the Lancaster Electric Light Company, of Lancaster, Ohio.

Mr. H. L. Harris has succeeded Mr. L. D. Lovett as superintendent of electric lighting for the Texarkana (Tex.) Gas & Electric Company.

Mr. A. S. Jourdan has been appointed superintendent for the Housatonic Power Company at Branford, Conn., succeeding Mr. E. T. Gilbert.

Mr. J. C. Anderson has succeeded Mr. N. H. Chapman as manager of the Monte Vista Light, Heat & Power Company of Monte Vista, Col.

Mr. J. E. Noeggerath, consulting electrical engineer, New York, has returned from a nine months' visit to Norway, Sweden and Germany.

Mr. W. A. McClellan has been appointed superintendent and chief electrician of the Abbeville (Ala.) electric-light plant, succeeding Mr. W. M. Voss.

Mr. Edward Hanson, late of the Montreal Light, Heat & Power Company, has been appointed superintendent of electric lighting at Saskatoon, Sask.

Mr. George J. Cadwell, one of the well-known electrical men of the Northwest, is now power engineer for the Minneapolis General Electric Company.

Mr. H. A. Goodridge, manager of the Alamosa (Col.) Mutual Electric Light & Power Company, has been appointed a vice-president of the company.

Mr. H. L. Heffner has succeeded Mr. A. W. Lindgren as manager and superintendent of the Huntington Beach (Cal.) Electric Light & Power Company.

Mr. Charles M. Duncan has become manager of the Arvada Electric Company of Arvada, Col., succeeding Mr. W. Corson, who formerly held that position.

Mr. M. P. Jemison, formerly vice-president of the Tuscaloosa (Ala.) Ice & Light Company, has succeeded Mr. Robert Jemison as president of the company.

Mr. W. H. Hodge, manager of the publicity department of H. M. Byllesby & Company, of Chicago, is making an extended trip to the Pacific Coast properties of that company.

Mr. Motosuke Masuda, chief engineer of the Tokio (Japan) Municipal Railway, is on a visit to the United States to study electric-railway operating conditions in the principal cities.

Mr. C. A. Howe, manager for the Holophane Company of Canada, Toronto, addressed the March meeting of the Hamilton (Ont.) Section of the National Electric Light Association on the subject of "Illumination."

Mr. W. A. Ostrom, chief electrician in the Saskatoon (Sask.) power house for the past year, has resigned to enter again the employ of the Canadian General Electric Company as superintendent of construction in the West.

Mr. Theodore N. Vail, president of the American Telegraph & Telephone Company and the Western Union Telegraph Company, has been elected a member of the corporation of the Massachusetts Institute of Technology, Boston.

Mr. H. H. Smith, head of the research department for the Edison Storage Battery Company, Orange, N. J., addressed the March meeting of the Cleveland Engineering Society on the subject of electric traction by means of storage batteries.

Mr. Julian C. Smith, superintendent of the Shawinigan Water & Power Company, Montreal (Que.), has been made a member of the Institution of Electrical Engineers of Great Britain. There are now eight members of the Institution in Canada.

Mr. A. J. Kennedy, formerly manager for the lamp department of the Westinghouse Electric & Manufacturing Company's Los Angeles office, has joined the firm of B. F. Kierullf, Jr., & Company, Los Angeles, as sales manager of its electrical equipment department.

Mr. F. L. Dame, who resigned recently as vice-president of the Electric Bond & Share Company, is at Daytona, Fla., for the remainder of the winter season after taking a motor trip from Jacksonville to Miami. Mr. Dame will remain at Daytona until some time in April enjoying a rest.

Mr. J. D. Lyon, who resigned recently as commercial manager of the Union Gas & Electric Company of Cincinnati, Ohio, has opened an engineering office at 410 Mercantile Library Building, Cincinnati, where he will specialize in the supervision and operation of existing plants and properties, in addition to general consulting work.

Mr. C. H. Ellis has been appointed manager of the Ariston Ice & Electric Company, of West Palm Beach, Fla., which was recently purchased from the W. S. Barstow Company by a local corporation headed by Mr. H. C. Adams. Mr. Ellis was formerly manager of the municipal plant at Tallahassee, Fla. At West Palm Beach he succeeds Mr. R. E. Childs.

Mr. Alvin Schlarbaum has resigned his connection with Messrs. Smith, Kerry & Chase as assistant engineer on the Healey Falls development, to become hydroelectric engineer for the Riordan Pulp & Paper Company, Ltd., of Hawkesbury and Merritton (Ont.). This company plans to develop 9000 hp on the Rouge River to meet the demands of recent extensions to its plant.

Dr. W. F. M. Goss, dean of the schools of engineering, University of Illinois, Urbana, is to make the principal address at the reception at Leipzig, Germany, June 22, with which the Verein Deutscher Ingenieure will welcome the party of members of the American Society of Mechanical Engineers who are to make the trip to be present at the Verein's fifty-fourth annual meeting.

Mr. C. R. Smith, designer of stations for the General Electric Company, who has been in charge of the reconstruction work of the Newport News & Old Point Railway & Electric Company at Hampton, Va., since April, 1912, has returned to the General Electric Company, having completed the rebuilding of the station and ice-making plant at Hampton. The property in question is owned by Messrs. Allen & Peck, of Syracuse, N. Y.

Mr. D. H. Macdougal has been appointed assistant to Mr. R. J. Fleming, general manager of the Toronto Electric Light Company, Toronto, Ont. Mr. Macdougal was formerly treasurer of the Electrical Development Company and assistant comptroller of the Toronto Power Company. He has been connected with the water-power companies at Niagara Falls since March, 1903.

Mr. John W. Ellis, of Woonsocket, R. I., has been placed in general charge of the work of electrification of the New York, New Haven & Hartford Railroad between Providence and Boston, the active supervision being in the hands of his son, Mr. John Ellis. The latter has for eighteen years served as chief electrician for the Lonsdale company, in which position he is succeeded by Mr. James Pennien, Jr.

Mr. J. M. Curtin, heretofore assistant manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company, has been appointed manager of this department to succeed Mr. Charles Robbins. Mr. Curtin is an electrical engineering graduate of the Pennsylvania State College and has been continuously identified with this company since his graduation in 1898.

Mr. Alexander Dow has been elected to the presidency of the Detroit Edison Company, as well as the Peninsula Electric Light Company. Mr. A. C. Marshall, formerly assistant to the president, succeeds Mr. Dow as vice-president. Mr. Dow retains his position as general manager. Mr. J. V. Oxtoby continues as vice-president with Mr. Marshall, while Mr. S. C. Mumford is made secretary in addition to his duties as comptroller.

Mr. M. C. Osborn, contract agent for the Washington Power Company of Spokane, Wash., addressed the Tacoma Jovian Luncheon League at its recent luncheon, taking the ground that municipalities should be permitted to charge owners of property with the expense of installing cluster lighting on streets, the city then maintaining the lamps. Mr. A. L. Thorn, superintendent of city lighting, also spoke on the subject, taking the same view. A measure of this nature is now being considered by the Legislature.

Mr. Marshall E. Sampsell, president of the Central Illinois Public Service Company of Mattoon, Ill., was elected president of the Illinois Electric Railways Association during its recent Chicago meeting. Mr. Sampsell was born at Marshall, Tex., in 1874, and was graduated from the University of Chicago with the class of 1896. In 1910 he was appointed president of the Mattoon company and of the Central Illinois Traction Company, which offices he continues to hold. Mr. Sampsell, as receiver for the Chicago Union Traction Company and the North & West Chicago Street Railway, took an active part in the settlement of Chicago traction matters in 1907 and 1910.

Mr. Charles Robbins, since 1909 manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company, has been appointed assistant sales manager of the company, with headquarters at East Pittsburgh. Mr. Robbins, who has been associated with the Westinghouse Electric & Manufacturing Company for the past fourteen years, was for a number of years located in New York City. Previous to 1899 he was associated with the Cutter Company of Philadelphia. He is a member of the National Electric Light Association and the American Institute of Electrical Engineers, having been closely identified with the latter organization in connection with the standardization work as a member of the committee on rating. His successor is Mr. J. M. Curtin.

Dr. Ira N. Hollis, for twenty years professor of engineering at Harvard University, has accepted the presidency of the Worcester Polytechnic Institute, of Worcester, Mass. Dr. Hollis will succeed on July 1 Dr. Levi Conant, who has served as acting president during the past two years. The new president has been professor of engineering at Harvard since 1893. He was born at Mooresville, Ind., in 1856, and is a graduate of the United States Naval Academy, class of 1878. Professor Hollis is widely known as an expert in the special department of steam-plant practice. One of his most recent investigations has been the use of the low-pressure turbine in the Cambridge (Mass.) Electric Light Company's plant. He is president of the Engineers' Club of Boston and a member of a number of national engineering societies.

Mr. A. C. Harrington has succeeded Mr. W. J. McCorkindale as manager of the Marquette County Gas & Electric Company, Marquette, Mich. Mr. McCorkindale's resignation to become manager of the Wilmington (Del.) Gas Company was noted in these columns recently. Mr. Harrington entered the field of electrical construction in 1888 and later had charge of electric railway projects for the Edison electric company in both London and St. Petersburg. He served as designer and active manager during the construction of the Pennsylvania & Erie Rapid Transit Railway and recently acted as supervising engineer for a large hydroelectric plant in Utah. In the operating field Mr. Harrington has served as manager of the South Covington & Cincinnati Railway Light, Gas & Power Company.

Mr. Leigh S. Keith, the new member of the firm of McMeen & Miller, Inc., and its secretary and treasurer, is a graduate of the Massachusetts Institute of Technology. His first experience was in the engineering department of the New York Telephone Company. During his later years with that company he devoted his efforts to making special investigations under the direction of the chief engineer. About four years ago he entered the employ of McMeen & Miller, and he has been engaged in a wide variety of engineering work, relating particularly to public-service investigations of light, power and telephone properties and special problems in electric railway work, such as the location of substations, the design of feeder systems and the prevention of electrolysis. For the past three years Mr. Keith has been managing engineer, so that in becoming one of the principals the change involved is more one of name than one of function.

LEIGH S. KEITH

Obituary

Edward H. Sturtevant, vice-president and director of the Franklin (N. H.) Power & Light Company, died March 8, aged sixty-seven.

Francis Boradnax, a consulting engineer residing at Montclair, N. J., died at Utica, N. Y., March 15. Mr. Boradnax was sixty years of age and, among other work, installed the electric-lighting plant at the Chicago World's Columbian Exposition in 1893.

Charles T. Bishop, treveling auditor for the H. W. Johns-Manville Company, died in St. John's Hospital, Brooklyn, N. Y., March 11, of appendicitis. Mr. Bishop was fifty-two years of age and had formerly been connected with the naval service.

Henry H. Furbish, a retired wood-pulp manufacturer, who died March 12 at Bath, N. Y., early conceived the commercial future of electric lighting and introduced arc lamps into his pulp mill at Berlin, N. H., years before any similar installation was in use in the district. Later he organized the Berlin Electric Light Company, one of the first central-station undertakings in New England, and served as its first president. Mr. Furbish retained his interest in this company until his death.

Robert E. Steele, comptroller of the General Electric Company, died at his residence near Schenectady, N. Y., March 4, at the age of forty-four. Mr. Steele was an attorney by profession and had served as Deputy Attorney-General for the State of New York. His financial knowledge figured prominently in the readjustment of the affairs of the Knickerbocker Trust Company of New York following its failure. Mr. Steele was appointed comptroller of the General Electric Company May 11, 1908.

Construction

New England

NORTHPORT, MAINE.—The town of Northport has voted to contract with the Penobscot Bay El. Co., of Belfast, for the installation of a street-lighting system. The contract provides for 15 street lamps. The company will extend its transmission line from Little River to the entrance of the Wesleyan Grove Campmeeting Association grounds.

PORTLAND, MAINE.—Extensions to the ornamental street-lighting system will be made this year if an appropriation is granted. Ornamental standards carrying four-lamp clusters will be erected.

WOODSVILLE, N. H.—The Woodsville Aqueduct Co. is rebuilding its electric plant recently destroyed by fire. The company has contracted with the General El. Co. for two 150-kw, 2200-volt, three-phase, 60-cycle generators with directly connected exciters and necessary switchboard equipment; also for one 10-kw constant-current transformer for street circuits. The contract for one 125-hp Rollins engine, shafting and pulleys has been awarded to Charles Griffen, of Lowell, Mass. The other equipment consists of one 130-hp Phoenix boiler, two waterwheels, one 165-hp S. Morgan Smith and one 150-hp Holyoke Machy. Co., with Lombard governors. Fort Wayne meters are used. G. E. Mann is chief engineer and electrician.

EAST LONGMEADOW, MASS.—At a town meeting held recently it was voted to add 50 more street lamps to the 90 already installed.

MILFORD, MASS.—The Worcester Suburban El. Co., of Uxbridge, has petitioned the Selectmen for a franchise to erect transmission lines on the Park Hill Road.

WORCESTER, MASS.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 25, for a conduit and wiring system, gas piping and lighting fixtures for the United States post office, Worcester, Mass., in accordance with drawings and specifications, copies of which may be obtained at the aboxe office or from the office of the custodian, Worcester. O. Wenderoth is supervising architect.

NEW BRITAIN, CONN.—Plans for the new street-lighting system prepared by Dr. Louis Bell, of Boston, Mass., will be submitted to the Public Works Board. It is understood that the plans provide for 64 flaming arc lamps, 200 250-watt incandescent lamps and 560 smaller incandescent lamps.

NEW LONDON, CONN.—The Rockville-Willimantic Ltg. Co., of New London, has applied to the State Legislature for permission to increase its capital stock from $700,000 to $1,000,000.

Middle Atlantic

ALBANY, N. Y.—Governor Sulzer has signed the bill giving the common councils of second-class cities the right to establish, alter or extend a special lighting district for ornamental street-lighting purposes. The bill was introduced for the benefit of the city of Troy.

ALBANY, N. Y.—The Senate judiciary committee on March 12 reported favorably on the Murtaugh hydroelectric bill providing for the development of electricity at the dams of the barge canal on the Mohawk River. This bill has been amended so as to empower the state conservation commission to establish hydroelectric districts in other parts of the State. The bill carries an appropriation of $600,000 for the establishment of a plant at Crescent.

BUFFALO, N. Y.—Sealed proposals will be received by the commissioner of public works, Room 5, Municipal Building, Buffalo, until April 4 for furnishing and installing heating, plumbing and power-plant equipment in connection with the erection of a new high-school building, to be known as the Masten Park High School, to be located in Masten Park. Separate proposals must be submitted for the following divisions of the work: (b) Heating, ventilating and power plant equipment, including boilers, pumps, tanks, fans, motors, high-pressure piping, radiation, temperature regulators, air washers, humidifiers, etc.; (c) plumbing, drainage and gas fitting, including water heaters, water purifiers and filtration apparatus, vacuum cleaning system, cooking stoves, ranges, etc. Plans and specifications are on file at the office of the deputy building commissioner, Room 6, Municipal Building, where blank proposal forms may be obtained. Francis G. Ward is commissioner of public works.

JAMESTOWN, N. Y.—The report of Clayton O. Johnson, superintendent of the municipal electric-light plant, to the commissioners recommends the installation of a new turbo-generator unit and a mechanical stoker in the municipal electric plant.

NEW YORK, N. Y.—Sealed bids will be received by R. Waldo, police commissioner, at bookkeeper's office, 240 Centre Street, borough of Manhattan, until March 25, for furnishing and erecting all materials required for construction and installation of new underground cables necessary to transfer police telephone service from old to new police headquarters, Brooklyn, and install police telephone service at new police stations, Beach and Varick Streets, East Fifth Street, West One Hundred and Twenty-third Street and Simpson Street, borough of the Bronx. Blank forms together with copy of contract, including specifications, may be obtained upon application at the office of the superintendent of telegraph, headquarters of Police Department, 240 Centre Street, New York.

POUGHKEEPSIE, N. Y.—The Moline Plow Co., of Poughkeepsie, it is understood, will equip its plant to be operated by electricity. Energy for operating the works will be supplied by the Central Hudson Gas & El. Co., of Poughkeepsie.

PITTSBURGH, PA.—Additional generating units will be installed at the Brunots Island power house of the Duquesne Lt. Co., increasing the output of the plant by 98,000 hp. Four new turbines have been ordered.

PITTSBURGH, PA.—The West Penn. Trac. Co. is contemplating enlarging its Connellsville power plant during the next two years Orders have been placed with the Westinghouse El. & Mfg. Co. for two turbines of 24,000 hp each. The cost of the work is estimated at $500,000.

SUNBURY, PA.—Owing to the restrictions placed on the Northumberland County Gas & El. Co., which wished to erect high-tension transmission lines in this city, the company, it is reported, has decided to move its power plant from Sunbury to Northumberland.

BEVERLY, N. J.—The Public Ser. El. Co. will reconstruct its transmission lines and cables in Beverly and vicinity. In connection with this proposed improvement the Borough Council is negotiating with the company for the installation of an underground conduit system for such service lines through Beverly.

BOONTON, N. J.—The Boonton El. Co. has applied to the Hanover Township committee for a franchise to operate in the Mountain Lakes and Parsippany districts.

FREEHOLD, N. J.—The Board of Utility Commissioners has granted the Monmouth Ltg. Co., of Freehold, permission to issue $14,000 in first-mortgage bonds and $2,500 in emergency notes to provide for extensions.

JAMESBURG, N. J.—The electric plant of the Jamesburg Lt. & Wtr. Co. was destroyed by fire on March 8, causing a loss of about $10,000. It is understood that the plant will be rebuilt at once. Frederick Greenslade is superintendent.

LINDEN, N. J.—Bids will be received by the Borough Council until March 25 for lighting the streets of the borough with electricity for a term of five years. Bids are to be submitted for furnishing 76 lamps of 32 cp, to be placed where directed by the Council. Clarence H. Smith is borough clerk.

NEWARK, N. J.—The Roseville Business Men's & Citizens' Association has appointed a lighting committee to negotiate with the Pub. Ser. El. Co. for additional electric lamps in the Roseville section and to secure estimates of cost.

CAMBRIDGE, MD.—The contract for installing an electric-lighting system at the Cambridge Hospital has been awarded to the Cambridge Gas, El. Lt. & Pwr. Co. The contract also calls for complete equipment for the X-ray department.

SHARPSTOWN, MD.—Bids will be received by the State Road Commission until March 27 for operating machinery and lighting for the draw span of the Sharpstown bridge over Nanticoke River in Dorchester and Wicomico Counties. William L. Marcy, 534 North Howard Street, Baltimore, is secretary.

EASTVILLE, VA.—Plans are being considered for the installation of an electric-light plant here. Stanley Scott, of Eastville, is interested in the project.

WASHINGTON, D. C.—Plans are being prepared by Walter C. Allen, electrical engineer, of the District of Columbia, for the installation of an ornamental street-lighting system between the Capitol and the Treasury Building, on Pennsylvania Avenue, for which Congress has appropriated $8,000. The plans provide for the substitution of 1500-cp lamps for the 700-cp lamps now in use.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the general supply committee, Treasury Department, Washington, D. C., until April 15, on blanks supplied by the general supply committee, for furnishing supplies for the executive departments and independent establishments of the government for the fiscal year ending June 30, 1914, as follows: Stationery, including drafting supplies, hardware, etc.; electrical engineering and plumbing supplies; engraving, printing and lithographic supplies; incandescent electric lamps; incandescent gas-lamp supplies and motor trucks. R. O. Bailey is Assistant Secretary of the Treasury.

North Central

HASTINGS, MICH.—The Thornapple Gas & El. Co. is contemplating improvements to its local plant and Middleville plant this season, involving an expenditure of about $16,000. The plans provide for extensive repairs on the Middleville dam. Lewis W. Heath, of Hastings, is manager.

HIGHLAND, MICH.—At an election held recently the proposition to grant the Edison Illg. Co., of Detroit, permission to erect transmission lines on the highways of the township was carried.

IRONWOOD, MICH.—The Gogebic & Iron Counties Ry. & Lt. Co., of Ironwood, has increased its capital stock from $350,000 to $491,700.

LANSING, MICH.—The State Railroad Commission has authorized several companies, said to be owned by the Commonwealth Pwr. Co., to issue bonds aggregating $453,000, the proceeds to be used for improvements of the various plants. The bond issues were granted to the following companies: Pontiac Pwr. Co., $6,000; Saginaw Pwr. Co., $12,000; Consumers' Pwr. Co., $5,000; Commonwealth Pwr. Co., $102,000; Au Sable El. Co., $13,000; Economy Pwr. Co., $130,000; Au Sable Pwr. Co., $126,000; Grand Rapids-Muskegon Pwr. Co., $48,000; Bay City Pwr. Co., $4,000, and Flint El. Co., $7,000.

MARQUETTE, MICH.—The City Council has adopted a resolution appointing a special committee to inquire into the feasibility of a municipal telephone system. It is proposed to use the poles of the municipal electric light plant.

MARQUETTE, MICH.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 3 for a conduit and wiring system, gas piping, lighting fixtures, etc., in the United States post office and court house, Marquette, Mich. O. Wenderoth is supervising architect.

MOUNT CLEMENS, MICH.—The County Supervisors are contemplating the installation of an electric-lighting system at the county infirmary, the present lighting system being inadequate.

SAGINAW, MICH.—The Wilcox McKim Co. contemplates the installation of electrically driven machinery in its proposed new plant for the manufacture of steering gears, universal joints and other automobile parts.

CLEVELAND, OHIO.—Sealed proposals will be received at the office of the secretary of the director of public service, No. 104, City Hall, Cleveland, Ohio, until April 1, for surface condensers for the municipal electric-light plant, plans and specifications for which may be obtained at the office of the engineer of construction, Room 319, City Hall. W. J. Springborn is director of public service. W. H. Kirby is secretary.

COLUMBUS, OHIO.—Sealed proposals will be received at the office of the Board of Trustees of the Ohio State University, Columbus, until March 31 for two horizontal sectional water-tube boilers and two automatic underfeed stokers for the power plant at the university, in accordance with specifications prepared by William C. McCracken, chief engineer. Plans and specifications may be seen at the offices of the architect, the chief engineer and the secretary of the board. Carl E. Steel is secretary.

CORYVILLE, OHIO.—The County Commissioners have granted the Ohio Valley El. Ry. Co., of Huntington, W. Va., a franchise to erect transmission lines between Coryville and Ironton. The company will furnish electricity for lighting the streets and residences of Coryville. Arc lamps will be used for street lighting.

FINDLAY, OHIO.—The City Council has authorized the light committee of the Council to instruct the city solicitor to prepare a resolution by which bids can be secured for lighting the city streets.

IRONTON, OHIO.—Plans have been completed by the Ohio Valley El. Ry. Co. for the construction of a new car-house and power house in Ironton, to cost about $100,000.

SPRINGFIELD, OHIO.—Arrangements have been completed by the Springfield Lt., Ht. & Pwr. Co. for laying 4200 ft. of conduit in the central portion of the city this year.

WAPAKONETA, OHIO.—The Western Ohio Ry. Co., of Lima, has authorized the erection of two high-tension lines between Wapakoneta and St. Mary's, at a cost of about $20,000.

HAZARD, KY.—The Hazard El. Lt. & Pwr. Co., recently organized, is planning to erect a power plant on the Messer branch, near Hazard, at once, to cost about $10,000.

LEXINGTON, KY.—The Kentucky Utilities Co., of Lexington, has purchased a franchise to erect transmission lines through Montgomery County and work will begin on the erection of the lines at once. The company is also erecting a new transmission line to Winchester and to Mount Sterling.

MAYSVILLE, KY.—The City Council is considering the installation of a boulevard lighting system in the entire downtown district.

MIDDLESBORO, KY.—The Kentucky Utilities Co., of Lexington, which recently purchased the plant of the Middlesboro El. Co., contemplates enlarging the plant for the purpose of furnishing electricity for lamps and motors to the coal mines in Bell County.

WILLIAMSTOWN, KY.—J. M. Riley has purchased a franchise for the construction and operation of an electric light and power plant in Williamstown. Work will begin on the installation of the system at once.

LOGANSPORT, IND.—The Board of Works has awarded the contract for installation of an Alberger surface condenser in the municipal electric-light plant to the Reeves-Skinner Co., of St. Louis, Mo., for $12,783. The board will soon let contracts for the installation of coal and ash conveyors, for which an appropriation of $12,000 has been made.

MARTINSVILLE, IND.—We are informed that Charles J. and Edgar V. Mitchell were not granted a franchise to install an electric-light plant in Martinsville, as reported in the issue of March 1.

PLYMOUTH, IND.—The Plymouth El. Lt. & Pwr. Co. contemplates extending its system to several adjoining towns. The company was recently incorporated by C. D. Snoeberger, Virginia Snoeberger and Isaac Snoeberger.

TERRE HAUTE, IND.—The Springfield & Central Illinois Trac. Co. has applied to the Board of Public Works for a franchise to build an interurban railway on Walnut Street.

VINCENNES, IND.—The Board of Works has signed a contract with the City El. Ltg. Co. whereby the latter will supply electricity to operate and light the sewer pumping station and incinerating plant located 2 miles below the city, for a period of five years. Under the terms of the contract the city agrees to install two 15-hp motors and also to pay for the erection of the transmission line from the city limits to the plant and to pay the company $50 per month and 2 cents per kw-hr. for all energy used.

BROCTON, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, has submitted a proposition to the Village Board to furnish electricity in Brocton. The company asks for a 10-year franchise and a contract for street lighting. If granted a franchise a transmission line will be erected either from Newman or Oakland to supply the service.

DALLAS CITY, ILL.—The Dallas City Lt. Co. has petitioned the City Council for a 25-year extension of its franchise. The Mississippi River Pwr. Co. proposes to enter the city and purchase the local electric plant for $40,000; also to erect a transmission line from Niota to Dallas City, at a cost of $60,000.

PALMER, ILL.—The Village Board has granted the Hillsboro El. Lt. & Pwr. Co., of Hillsboro, a 50-year franchise to operate an electrical distributing system in Palmer.

PAXTON, ILL.—The Central Illinois Utilities Co. has purchased the property of the Paxton El. Co., of Paxton, and will take over the property immediately. It is understood that the new owners will make improvements to the plant. The Utilities company has franchises in a number of surrounding cities and towns, including Rankin, Fairbury, Arrowsmith and Gibson City. H. L. Clark is vice-president and general manager of the Central Utilities Co.

PERRY, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, has been granted a franchise by the Village Board to operate an electrical distributing system in Perry for a period of 50 years.

ROCK ISLAND, ILL.—The officials of the Rock Island Southern Ry. Co. are negotiating with a number of towns along and near the interurban railway to supply electricity for lamps and motors. The company is planning to erect transmission lines to places a considerable distance from its power plant.

SPRINGFIELD, ILL.—Sealed proposals will be received by the Board of Administration, Capitol Building, Springfield, until March 24 for the installation of conduits, wiring, electric lamps, etc., at the Illinois Industrial Home for the Blind, 1900 Marshall Boulevard, Chicago, Ill. Specifications will be furnished upon application to the managing office of the home at the above address. Frank D. Whipp is fiscal supervisor.

GREEN LAKE, WIS.—J. R. Stewart has been granted a franchise to furnish electricity for lamps in Green Lake.

HATFIELD, MINN.—Plans are being prepared for raising the large power dam at Hatfield 5 ft. above its present level. R. M. Howard is manager.

ROSEAU, MINN.—At an election held March 11 the proposition to issue bonds for the installation of a municipal electric-light plant was carried. As yet an engineer has not been engaged. P. H. Buran is clerk.

DAVENPORT, IA.—The People's Lt. Co., of Davenport, has begun work on the erection of a high-tension transmission line from this city to the substation of the Iowa & Illinois Ry. Co. at Pleasant Valley, a distance of 8 miles. From Pleasant Valley energy will be distributed to the various substations of the railway company. Electricity will also be supplied to the towns and villages along the lines for lamps and motors. The cost of the lines is estimated at about $40,000. The People's Lt. Co. also contemplates the erection of a transmission line between Walcott and Durant, a distance of about 7 miles, to cost about 30,000. This line will be a continuation of the line recently completed between Blue Grass and Walcott. If granted a franchise in Buffalo (at a special election to be held March 31) the company will erect a transmission line from Blue Grass, a distance of 6 miles. The cost of the line to Buffa'o is estimated at $25,000.

GREENFIELD, IA.—Sealed proposals will be received by M. C. McCreight, city clerk, Greenfield, Ia., until April 11 for furnishing, f.o.b. Greenfield, two generators, one 100-kva and the other 75-kva; switchboard, two constant-current regulators, one 15-hp motor and starting apparatus, line material, transformers, motors, one steam engine, one 225-boiler-hp feed-water heater, receiver, separator, and one 7-in. exhaust head, or for furnishing and installing the above-named apparatus complete with all necessary piping, etc., ready for operation. Instructions to bidders, plans and specifications may be seen at the office of the city clerk, Greenfield, or at the office of J. B. Hill, Iowa City, engineer. A complete set of plans may be obtained upon application to the engineer, for which a deposit of $5 will be required, the same to be refunded upon return of plans. H. J. Chapman is Mayor.

HAWKEYE, IA.—C. Miller & Sons, of Clermont, who were recently granted a franchise to furnish electricity here, will erect a transmission line from their plant in Clermont to Hawkeye. The substation will be equipped with a transformer to transform energy from 13,000 volts to 2300 volts; also with a number of transformers to step down the current from 23,000 volts to 110 and 220 volts; about 8 miles of No. 6 bare copper wire and 30-ft. poles will be used for overhead lines; 40-watt

Mazda lamps will be used for street-lighting and about 200 Westinghouse meters installed.

KIMBALLTOWN, IA.—At an election held March 10 the proposition to grant a franchise for the installation of an electric-light plant was carried. For further information address John Neilsen.

MEDIAPOLIS, IA.—L. E. Sherrill, of Burlington, representing the Walsh interests, of Burlington, is negotiating with the City Council with a view of securing a franchise to distribute electricity in Mediapolis. Energy will be supplied by the Mississippi River Pwr. Co., of Keokuk.

OSKALOOSA, IA.—An option has been taken on the property of the Oskaloosa Lt. & Trac. Co. by W. B. McKinley, of Champaign, Ill., president of the Illinois Trac. Co. The Oskaloosa company is capitalized at $350,000 and controls the electric-lighting and street-railway systems in Oskaloosa.

FESTUS, MO.—The Festus Glass Co., it is reported, contemplates the purchase of an engine, boiler, generator and motors and would like to receive prices on same. H. S. Warwick is manager.

PALMYRA, MO.—The Mississippi River Pwr. Co., of Keokuk, Ia., is negotiating with the City Council for a contract to sell energy in Palmyra. It is proposed to erect a transmission line from the company's distributing station in Ilasco to Palmyra, at a cost of $25,000. The municipal electric-light plant requires new equipment.

SPRINGFIELD, MO.—A franchise has been granted by the City Council to J. H. Rathbone, M. C. Baker and Roy Cox, of Springfield, for the installation of an electric-light plant This franchise will be submitted to the voters for approval at the municipal election to be held in April. E. C. McAfee, Baker Block, Springfield, is attorney for the company.

WILLOW LAKE, S. D.—At an election held March 4 the proposition to issue bonds for the installation of an electric-light plant was carried. Bids for construction of the plant will be asked for in about two months. J. F. Flindt is auditor.

BASSETT, NEB.—The contract for constructing an electric-light plant, bids for which were opened Feb. 17, has been awarded to the Alamo Engine & Supply Co., of Omaha, for $12,565. W. E. Buckenderf is clerk.

CANTON, KAN.—Bids will be received by the City Council of Canton until March 26 for the construction of municipal electric-light plant, including brick power house, one 60-hp oil engine, one 30-hp oil engine, 35-kw generator, 35-amp storage battery and eight counter cells, 10,000-gal. fuel tank, 15 steel electroliers, copper wire and pole-line material.

GOFF, KAN.—At a meeting held recently the citizens decided to install a waterworks system first. Later on it is expected that connection will be made with the Centralia plant for electric-lighting service. D. A. Steiner is superintendent of the Centralia municipal electric plant.

HOLTON, KAN.—Plans are being prepared by Worley & Black, engineers, Reliance Building, Kansas City, Mo., for improvements to the municipal electric-light plant, including line extensions, etc. The proposition to issue bonds for the work will be submitted to the voters on April 1.

JETMORE, KAN.—The installation of an electric-light plant in Jetmore is under consideration.

RUSSELL, KAN.—The proposition to issue bonds for the installation of an electric-light system will be submitted to the voters. It is proposed to secure electricity for operating the system from Chariton.

TURON, KAN.—Bids for construction of a combined electric-light plant and water-works system will probably be received the latter part of this month. A 50-hp steam plant will be installed. Rollins & Westover, of St. Louis, Mo., are engineers in charge.

Southern States

DURHAM, N. C.—The Durham Trac. Co. will install new 4-amp General Electric magnetite-arc lamps to replace the 6.6-amp series closed-arc lamps now in use as agreed under the terms of the new 10-year contract recently awarded by the city. The lamps will be maintained by overhead wires. The contract calls for a minimum of 200 arc lamps at $60 each per year. R. S. Lindsey is general manager.

WHITNEY, N. C.—H. B. Hardaway & Co., of Atlanta, Ga., have secured the contract for the construction of a large dam across the Yadkin River, near Whitney, for the Southern Aluminum Co., which recently acquired the Whitney property. The new dam will be of concrete and will be located about 7 miles below the old Whitney stone dam. It is estimated that about 45,000 hp will be developed at the plant now being constructed by the Southern Aluminum Co.

WILSON, N. C.—At an election to be held April 15 the proposition to issue $80,000 in bonds for improvements and extensions to the municipal electric-light plant will be submitted to the voters.

ANDERSON, S. C.—The properties of the Anderson Wtr., Lt. & Pwr. Co., including the Portman Shoals plant on the Seneca River, have been acquired by the Southern Pwr. Co., of Charlotte, N. C.

ABBEYVILLE, GA.—At an election to be held April 8 the proposition to issue $8,000 in bonds for the construction of a municipal electric-light plant will be submitted to a vote.

VIDALIA, GA.—The proposition to issue $15,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant and water-works system, will be submitted to the voters on April 5.

CHIPLEY, FLA.—The Chipley Lt. & Pwr. Co. has engaged the Solomon-Norcross Co., of Atlanta, Ga., to take charge of the construction of its proposed electric-light plant. A. A. Myers, Jr., is president.

LIVE OAK, FLA.—The property of the Live Oak El. Co., including ice and light plants, is reported to have been purchased by the Engineering Securities Co. (holding company) for J. G. White & Co., New York, for $50,000. It is understood that the new owners will combine and improve the plants.

MICANOPY, FLA.—Bids are wanted on equipment for an electric plant, including a 75-kva, 2300-volt, 60-cycle, three-phase generator, with switchboard, instruments, exciter, non-condensing, four-valve steam engine, 100-hp boiler with piping, feed-water pump; engine to be directly connected to generator. For further information address post office box 375, Gainesville, Fla.

BRISTOL, TENN.-VA.—The City Councils of Bristol, Tenn., and Bristol, Va., have awarded contracts to the Bristol Gas & El. Co. for the installation of an ornamental street-lighting system on practically all the business streets of the city, all wiring to be placed in conduits. The company has already awarded the contract for the five-lamp and three-lamp standards to the Union Foundry Co., of Anniston, Ala. S. M. Vance is general manager.

DYERSBURG, TENN.—Bids are being received by the business men of Dyersburg for the installation of an ornamental street-lighting system in the business section of the city.

NASHVILLE, TENN.—The Nashville Ry. & Lt. Co. has amended its charter providing for an extension of its street railway system.

JACKSON, MISS.—Plans are under consideration by the Council to acquire the plant of the Capital Lt. & Pwr. Co. Under the terms of the franchise of the company, the city is given an option to purchase the plant at the end of ten years, which expires in April.

ESTHERWOOD, LA.—The Town Council is considering the question of installing an electric-light plant to light the streets and residences in the village. The cost of the plant is estimated at $1,000.

GEORGETOWN, LA.—A franchise has been granted to Captain Rouse, of Poplarville, to install an electric-light plant in Georgetown, to be operated in connection with the proposed water-works system.

JENNINGS, LA.—The local electric-light plant, owned by C. C. Johnson, has been purchased by the Southern Ht. & Lt. Co, which owns and operates the local gas plant. The company contemplates building an addition to the gas plant at a cost of $10,000, to provide space for the equipment of the plant purchased and for additional turbines and generator.

FRANKLIN, TEX.—The Franklin Wtr. & Lt. Co. is rebuilding its power house which was recently destroyed by a storm. The steam plant will be abandoned and the plant will be driven by two gas engines. The company also proposes to rebuild its distributing system throughout the town.

MERCEDES, TEX.—Application has been made to the City Council by S. A. Robertson, of San Benito, for a franchise to operate an electric-light plant and water-works system. Mr. Robertson proposes to purchase and extend the local systems.

MOUNT PLEASANT, TEX.—Plans are being prepared for improvements to the local electric-light plant which will involve an expenditure of about $50,000. The Albert Emanuel Co., of Dayton, Ohio, has recently purchased the plant. The McCandless Engineering Co., of Kansas City, Mo., has charge of the engineering work.

SAN ANTONIO, TEX.—Work has begun on the survey of the proposed electric interurban railway between Austin and San Antonio. A large hydroelectric power plant will be installed on the Guadalupe River by the Guadalupe Pwr. Co., a subsidary of the interurban company, which will furnish electricity to operate the railway. John W. Maxcy is director and general manager.

WICHITA FALLS, TEX.—Plans have been adopted and a contract agreed upon by the City Council for lighting the streets of the city. The plans provide for 150 50-watt lamps throughout the residential districts and 90 ornamental standards, carrying five-lamp clusters, in the business section. The plans adopted contemplate the installation of 710 lamps, for which the city is to pay the company $4,200 per annum for maintenance. The contract covers a period of ten years.

Pacific States

CONCONULLY, WASH.—The local electric-light plant, owned by Morton & McDaniel, was recently destroyed by fire.

MONROE, WASH.—The Kirkland-Redmond Ry., Lt. & Pwr. Co. has completed surveys for an electric line between Kirkland and Monroe, a distance of about 20 miles. W. P. Perrigo is interested in the project.

QUINCY, WASH.—The Wenatchee Valley Gas & El. Co. has applied for a 50-year franchise to supply electricity in Quincy for lamps and motors. The company proposes to extend its transmission lines from Wenatchee to Quincy.

SEATTLE, WASH.—J. A. McQuaid has purchased the equipment and franchises of the Highland Park and Lake Burien Railway. Extensive improvements will be made to the system.

SPOKANE, WASH.—Application has been made to the City Council by Allen Van Rensselaer, of Victoria, B. C., Can., for a franchise to generate and distribute electricity for lamps, heaters and motors; also to install and operate a central steam-heating system in the downtown district in Spokane.

TOLEDO, WASH.—The property of the Toledo El. Co. has been purchased by the Independent El. Co., of Portland, Ore. It is understood that improvements are contemplated to the system.

ALBANY, ORE.—The City Council has indorsed the proposition of installing a cluster-lamp street-lighting system, plans for which were prepared by Louis C. Kelsey, consulting engineer, Selling Building, Portland, Ore.

HILLSBORO, ORE.—The installation of cluster lamps on Second, Third and Main Streets is under consideration.

PORTLAND, ORE.—The Portland Ry., Lt. & Pwr. Co. is making investigations in Pleasant Valley and Jennie Station on the Gresham electric railway, with a view of extending its electric-lighting service to that suburb.

PORTLAND, ORE.—Preliminary plans have been prepared by the Oregon El. Ry. Co. for the construction of a large hydroelectric power plant on the McKenzie River in Linn County. The equipment will consist of six pairs of 5000-hp tangential waterwheels driving six 6000-kva, 2300-volt generators. The transmission voltage will be 110,000. Active preliminary construction will begin in June. No contracts have yet been let and none are now pending. This year will be devoted to development work mainly. L. B. Wickersham is chief engineer and George S. Edmondstone, 536 Railway Exchange, Portland, Ore., is hydraulic engineer.

SPRINGFIELD, ORE.—Preparations are being made by the Oregon Pwr. Co. for the construction of a power plant on the headwaters of the McKenzie River, near Springfield. Bids are now being received for equipment.

COLUSA, CAL.—The Pacific Gas & El. Co., of San Francisco, is planning to extend its service to the south of Colusa in the near future.

LOS ANGELES, CAL.—The Bible Institute Building, located on Hope Street, near Fifth Street, will be equipped with a power plant. The purchasing department of the Union Oil Co. has charge of the purchases for the institute.

LOS ANGELES, CAL.—The Board of Public Works is asking for bids for the installation of ornamental lamp standards on Sixth Street from Alameda to Hill Street, Eighth Street between Main and Figueroa Streets, and Ninth Street from Main to Figueroa Street.

MARYSVILLE, CAL.—The Great Western Pwr. Co., of San Francisco, has applied to the Board of Supervisors of Yuba County for a franchise to erect transmission lines along certain streets and highways in Yuba County. Bids will be received by J. F. Eastman, clerk, until April 9, for the above franchise.

OAKLAND, CAL.—The Sierra El. Pwr. Co., Oakland, has applied for franchises to erect and operate distributing systems in Glenn, Plumas, Butt and Tehama Counties.

OCEANSIDE, CAL.—The Oceanside El. Co. has awarded the contract for extending its transmission lines into the San Luis Rey Valley to F. F. Foster Co., East Third Street, Los Angeles. The cost of the work is estimated at $20,000.

OWENSMOUTH, CAL.—The Southern California Edison Co. will begin work at once on the construction of a substation here for the purpose of furnishing electricity for lamps and motors in Owensmouth. A large part of the distributing lines will be placed in underground conduits. Owensmouth has not a post office.

POMONA, CAL.—The Pomona Home Tel. & Tel. Co. is planning the installation of an exchange in San Dimas, near Pomona. D. S. Parker is general manager of the company.

REDDING, CAL.—Application has been made to the Board of Supervisors of Shasta County by Albert C. Agnew, of Oakland, representing the Sierra El. Pwr. Co., for a franchise to build an electric railway and erect transmission lines on the highways and roads of Shasta County. Sealed bids will be received by S. N. Witherow, clerk, until April 7 for the above franchise.

RIVERSIDE, CAL.—The Southern Sierras Pwr. Co., of San Bernardino, is planning to extend its 10,000-volt transmission line through Riverside and San Bernardino into the city of San Diego, a distance of about 100 miles. Manifold & Pools are engineers.

SAN BERNARDINO, CAL.—The Southern Sierras Pwr. Co., of San Bernardino, is reported to be considering extending its transmission lines into Imperial Valley. Extensions are contemplated, it is stated, by the company, involving an expenditure of about $1,000,000.

SAN DIEGO, CAL.—The United Lt., Fuel & Pwr. Co. has applied to the State Railroad Commission for permission to issue $100,000 in bonds.

SAN FRANCISCO, CAL.—The Pacific Gas & El. Co. is planning to enlarge the Bear River canal, increasing the capacity from 50 second-ft. to 350-second-ft. of water.

SAN FRANCISCO, CAL.—The Great Western Pwr. Co. has petitioned the State Railroad Commission for permission to erect and operate an electric distributing system in Yuba County and Marysville.

WOODLAND, CAL.—The Oro Lt. & Pwr. Co., of Oroville, has applied to the Board of Supervisors for a franchise to erect transmission lines and supply electricity in Yolo County.

MALAD CITY, IDAHO.—The Evans Lt. Co., of Malad City, which recently purchased the property of the Idaho Lt. & Pwr. Co., will increase the power development as soon as the weather will permit by adding to its present conduit, thus gaining more head. D. L. Evans is owner of the plant and J. H. Campbell manager.

FARMINGTON, UTAH.—The Davis County Pwr. & Lt. Co., of Farmington, has sold its plant and holdings to the Utah Pwr. & Lt. Co., Salt Lake City, for $27,000. The property includes the hydroelectric power plant in Farmington Canyon and the Layton and south to Centerville transmission lines, both lines connecting with others now owned by the Utah company.

CALABASAS, ARIZ.—The Borderland Mines Co. is contemplating the installation of a large power plant at Calabasas. A transmission line will be erected to Oro Blanco, a distance of about 20 miles. T. C. Woodworth is president of the company.

TUCSON, ARIZ.—The Kelvin Sultana Mining Co. has awarded contract for the erection of a power plant on its property.

BOULDER, COL.—The City Council has passed the ordinance authorizing the proposition to issue $70,000 in bonds for the establishment of a municipal electric-light plant to be submitted to the voters at the April election.

SALIDA, COL.—The property of the Salida Lt., Pwr. & Utility Co. has been purchased by the bondholders' committee of the Central Colorado Pwr. Co., of Denver, Col. The price paid for the plant is said to be $350,000.

BUCKHORN, NEV.—The Buckhorn Mines Co. is planning to build a power plant at Beowawa and erect a 30-mile 33,000 volt transmission line from the plant to Buckhorn to furnish electricity to operate its mill. Work on the proposed plant will begin in April. A. N. Voss, electrical engineer, will have charge of the electrical work.

FORT BAYARD, N. M.—Sealed proposals will be received until April 4 for furnishing three transformers and one motor at Fort Bayard. Further information may be secured on application to the quartermaster at Fort Bayard.

Canada

CALGARY, ALTA., CAN.—The Calgary Pwr. Co. has decided to develop another water-power at Kananaskis Falls, located 2 miles above the present Horse Shoe Falls plant, at a cost of about $1,000,000.

ABBOTTSFORD, B. C., CAN.—The Western Canada Pwr. Co., of Vancouver, expects to begin within 30 days the erection of a distributing system in the municipality of Matsqui. Transmission lines will be erected to the pumping stations at the government diking project soon.

VERNON, B. C., CAN.—Tenders will be received by D. G. Tate, city clerk, Vernon, B. C., until April 11 for furnishing and installing one 500-hp. Diesel engine and one 375-kw, 2300-volt, three-phase, 60-cycle generator with directly connected exciter and one 10-ton traveling crane. Specifications may be seen at the office of Mather, Yuill & Co., Ltd., Vancouver, B. C., consulting engineers.

ST. JOHN, N. B., CAN.—Preparations are being made by the New Brunswick Hydro-Electric Co. to begin work on a water-power development located about 50 miles from this city. It is estimated that from 15,000 hp to 20,000 hp can be developed. The charter of the company gives it the right to supply electricity in St. John.

AURORA, ONT., CAN.—L. H. Herdt, engineer, of Montreal, engaged by the Town Council to examine and determine the relative advantages to the town of the systems of the Hydro-Electric Power Commission and the Toronto & York Radial Ry. Co. for electrical service, has recommended to the Council the adoption of the Toronto & York Radial Ry. Co.'s offer.

ELMIRA, ONT., CAN.—Arrangements have been made between the Town Council and the Elmira Milling Co. whereby the town of Elmira will take over the electrical distributing system of the company, at a valuation of $3,000, to be owned and operated by the municipality. Energy to operate the system, it is understood, will be secured from the Hydro-Electric Power Commission.

GLENCOE, ONT., CAN.—The installation of hydroelectric power is contemplated, energy to be obtained from the Hydro-Electric Power Commission of Ontario.

LONDON, ONT., CAN.—Electrical extensions are contemplated during the coming year involving an expenditure of about $125,000, which will include new work shops, new substation equipment, including power transformers, lighting regulators and synchronous motor, electric generating plant at Springbank, substation No. 4, with equipment, line transformers, light and power meters, etc.

OTTAWA, ONT., CAN.—The erection of a new substation, to cost about $75,000, is contemplated by the Ottawa El. Ry. Co.

OTTAWA, ONT., CAN.—Plans have been prepared by the Electrical Department for new equipment and extensions to municipal electric-light

plant, to cost about $22,000. The purchase of lamp standards and lamps for the ornamental street-lighting system recently adopted by the Council is under consideration.

PORT ARTHUR. ONT., CAN.—Sealed tenders will be received by J. J. Hackney, commissioner of utilities, until March 31, for railway material as follows: Tender A—8 tons of 00 trolley wire and 6¾ tons of No. 0000 flexible feeder wire (D. B. W. P.). Tender B—Miscellaneous track material, including rails, spikes, angle bars, bolts, etc. Tender C—Steel intersections, frogs, switches, etc. Further instructions as to specifications, blueprints and form of tender may be obtained from the city engineer and the commissioner of utilities.

TORONTO, ONT., CAN.—Tenders will be received by registered post only, addressed to the chairman of the Board of Control, City Hall, Toronto, until April 1, for overhead and pole line material, including trolley wire cable, suspensions, hangers, pull-overs, sleeves, ears, frogs, bolts, bonds, etc. Specifications and tender form may be obtained upon application at the office of the purchasing section, Department of Works, City Hall, Toronto. H. C. Hocken, Mayor, is chairman of board of control.

WINGHAM, ONT., CAN.—The electric light committee has recommended to the Town Council the installation of a duplicate generator to be installed at the municipal electric-light plant, at a cost of about $6,000.

MONTREAL, QUE., CAN.—Tenders are being asked for supplies for an underground conduit system on St. Catherine Street from Guy Street to Papineau Avenue.

MONTREAL, QUE., CAN.—The Quebec Public Utilities Commission has ordered the removal of all poles from St. Catherine Street, Montreal. The city contemplates an expenditure of $5,000,000 to place all wires underground.

OXBOW, SASK., CAN.—The installation of an electric-light plant, to cost $12,000, is under consideration.

Miscellaneous

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until April 5 for furnishing reversing motor planer equipment, motors, structural steel, cast-iron pipe and fittings, etc., under Circular No. 766, copies of which may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing agent.

New Industrial Companies

THE C. & B. ELECTRIC SIGN & CONSTRUCTION COMPANY, of Atlantic City, N. J., has been incorporated by H. Cullenbach, W. Each, Jr., and J. P. Johnson, of Atlantic City. The company is capitalized at $100,000 and proposes to do electric light and power construction work.

THE CENTRAL MOTOR SUPPLY COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $30,000 to deal in electrical and mechanical devices. The incorporators are: P. B. Barager, 19 Pacific Street; R. F. Close, 131 Lark Street; W. Wood, 17 Hanna Place, and C. W. Galliger, 641 Garson Avenue, all of Rochester, N. Y.

THE HECCO DEVELOPMENT COMPANY, of Portland, Maine, has been incorporated with a capital stock of $2,500,000, for the purpose of doing a general electrical engineering business, etc. The officers are: A. F. Jones, president; A. A. Richards, treasurer, and A. F. Jones, clerk, all of Portland.

THE NATIONAL REFILLABLE FUSE COMPANY, of Chicago, Ill., has been chartered with a capital stock of $50,000 to manufacture electrical appliances. The incorporators are: E. G. Woods, I. Grossman and L. Goldstein, of Chicago, Ill.

SHOCKLESS ELECTRIC MANUFACTURING COMPANY, of Kirkwood, Ill., has been incorporated with a capital stock of $150,000 by C. E. Luburg, H. L. Conrad and F. N. Richardson, of Kirkwood. The company proposes to manufacture machinery.

New Incorporations

LOS ANGELES, CAL.—The Midland Counties Pub. Ser. Co. has been incorporated with a capital stock of $2,500,000 by Kasper Cohn, A. C. Balch, H. P. Baumgartner and B. R. Myers.

CHICAGO, ILL.—The Egyptian El. Co. has been incorporated with a capital stock of $25,000 to operate electric light, heat and power plants. The incorporators are: A. A. Rolf, A. E. Stern and M. J. Mears, all of Chicago.

DECATUR, ILL.—The Star El. Co. has been incorporated with a capital stock of $3,000 by Richard B. Hall, James A. Goodale and D. M. Clifford. The company proposes to furnish electricity for lamps and to do a general electrical business.

HAZARD, KY.—The Hazard Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by W. E. Hemphill, B. P. Wooten and J. T. Lovelace.

BOSTON, MASS.—The American Lt., Ht. & Pwr. Co., has been incorporated with a capital stock of $150,000 by L. H. Schneider, M. Ward and A. L. Whittier, of Boston, Mass.

ST. LOUIS, MO.—The Perry County Pub. Utilities Co. has been granted a charter with a capital stock of $40,000 to generate and distribute electricity for lamps, heaters and motors. The incorporators are: Judson H. Boughton, A. D. Brinkerhoff and W. C. Morehead.

BEAVER FALLS, N. Y.—The Beaver Falls River Pwr. Co. has filed a certificate of incorporation with the Secretary of State. The company is capitalized at $300,000 and proposes to engage in the manufacture of pulp and paper and to develop electrical power on the Beaver River to supply electricity for the present mill at Beaver Falls, owned by the J. P. Lewis Co. The incorporators are: H. S. Lewis and H. L. Van Ornam, of Beaver Falls.

WOODLAND, N. C.—The Woodland El. Lt. & Pwr. Co., has been incorporated with a capital stock of $25,000 by E. G. Griffin, C. J. Parker and R. C. Bonthall. The company is now building a power plant at a cost of about $4,000.

WHEELING, W. VA.—The Wheeling Valley Lt. & Pwr. Co. has been granted a charter with a capital stock of $50,000 to do a lighting, heating and power business. The incorporators are: John W. Adams, M. S. Adams, Harry L. Bond and E. L. Bond, all of Wheeling.

TORONTO, ONT., CAN.—The International Lt. & Pwr. Co. has been incorporated with a capital stock of $20,000,000. The charter of the company gives it power to construct and operate electric and hydraulic plants and to take over or consolidate with other companies and to operate subject to municipal and provincial regulations. J. S. Lovell, Madison Avenue, Toronto, and others appear as nominal incorporators.

Trade Publications

BUSHINGS.—The Steel City Electric Company, Pittsburgh, Pa., has recently issued a leaflet on its bushings and lock-nuts, known as Bulletin A, which illustrates and describes these devices and gives the latest list prices.

STAGE LIGHTING ACCESSORIES.—The Universal Electric Stage Lighting Company, 238 West Fiftieth Street, New York, has issued a supplement to Catalog F, which in its twelve pages illustrates and describes a number of stage-lighting accessories, such as pockets and plugs, stage connectors, arc connectors, connectors for dry batteries, chandelier connecting boxes, motion picture spot-lamps and other devices.

FUSETTE.—The Electric Appliance Company, Chicago, is sending out a small folder telling about the Paiste fusette. The fuse is carried in a small porcelain piece separate from the holder into which it fits when in use. When the fuse blows the small fusette can be discarded and another substituted in the same holder, and the same holder can be used for many fusettes, the cost of which is less than that of ordinary fuse plugs.

BUILDING EQUIPMENTS.—Bulletin No. 115, entitled "Electrical Equipment for Buildings," of the Sprague Electric Works of General Electric Company presents descriptions and excellent illustrations of electrical apparatus installed in some of the recently erected office buildings, hotels, theaters and other structures in different parts of the country. Numerous installations are shown, including in addition to the usual equipment a vacuum-cleaner system, a refrigerating machine, dishwasher, laundry machine, ozonator and other classes of apparatus.

AUTOMOBILE CHARGING PLANTS.—In a twelve-page pamphlet recently issued by the Electric Products Company, 6536 Carnegie Avenue, Cleveland, Ohio, the reasons why owners of electric automobiles should use the Wotton method of automatic charging are set forth in a clear manner. The Wotton automatic rectifier, automatic rheostat and automatic cut-off panels are illustrated, and brief descriptions of their constructive features are given. The manufacturer claims for the Wotton method of charging the elimination of many ills which improper charging produces.

WIRES AND CABLES.—The Atlantic Insulated Wire & Cable Company, 120 Liberty Street, New York, has recently issued a booklet giving new list prices and freight additions on its Dolphin brand new-code wires and cables for 600-volt service. This list is drawn up as a new universal code in the interest of uniformity, at the request of the general consumers, contractors and supply houses, many of which have already incorporated it in their catalogs. This booklet enables buyers to have constantly before them a complete range of copper prices, without awaiting receipt from the manufacturers of a new list each time the copper base changes.

Business Notes

THE THOMPSON ELECTRIC COMPANY has moved its offices and assembling shop from 337 Superior Avenue, N. W., to 102 St. Clair Avenue, N. W., Cleveland.

THE GLOBE PORCELAIN COMPANY, which has been organized for the manufacture of electrical porcelain specialties, has established offices and factory at Mulberry Street and St. Joe's Avenue, Trenton, N. J. The president of the company is Mr. Joseph Steinert, of the Joseph Steinert Machine Works, Trenton. Mr. W. R. Gaskill is the secretary.

ELLIOT & BALL COMPANY.—The advertising service which has been conducted for several years under the name of the Berton Elliot Publicity Service, at the Engineers' Building, Cleveland, has been incorporated under the title The Elliot & Ball Company, with Mr. Berton Elliot as president and Mr. E. H. Ball, who has been associated with the business almost from the start, as secretary and treasurer. The address remains unchanged.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 11, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,055,327. MEANS FOR PREVENTING CORROSION OR UNDERGROUND METALLIC STRUCTURES; C. Hering, Philadelphia, Pa. App. filed Nov. 27, 1908. The ground water is used as the return circuit.

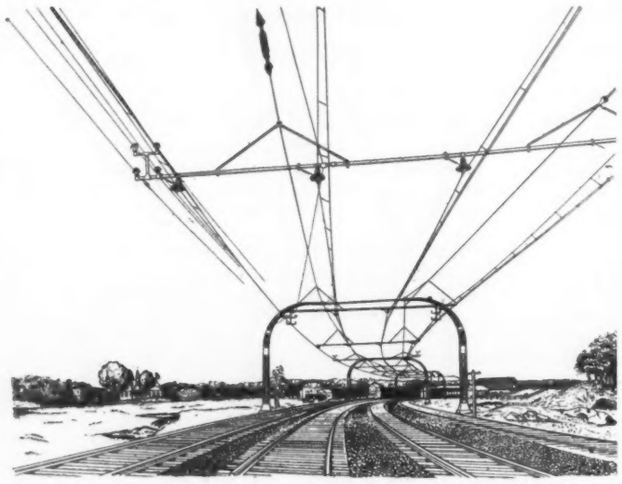
1,055,331. APPARATUS FOR CARRYING OUT GAS REACTIONS PARTICULARLY FOR THE PRODUCTION OF OXIDE OR NITROGEN IN THE ELECTRIC ARC; W. Kochmann, Berlin, Germany. App. filed July 18, 1910. Uses a cone of arcs.

1,055,332. INSULATOR; H. A. De Long, Ephrata, Pa. App. filed Aug. 15, 1912. Grooved-pole line insulator.

1,055,361. ARC LAMP; R. Scott, Wilkes-Barre, Pa. App. filed Sept. 24, 1906. Electromagnetically deflected flaming arc.

1,055,362. ALTERNATING-CURRENT MACHINE; S. Senstius, Cincinnati, Ohio. App. filed April 11, 1908. Compensated repulsion motor.

1,055,366. ELECTRICAL ACCUMULATOR; P. K. Stern, New York. App. filed May 12, 1909. Non-conducting sectional casing for the grids.



1,055,782.—Overhead-Line Structure for Electric Railways

1,055,446. THERMOSTAT AND THERMOMETER; L. G. Copeman, Flint, Mich. App. filed July 28, 1911. For electric oven.

1,055,469. EXPRESSION DEVICE FOR AUTOMATIC PIANOS AND SIMILAR MUSICAL INSTRUMENTS; M. M. Kastner and C. Katz, London, England. App. filed Aug. 2, 1910. Accelerates the exhaust.

1,055,504. SALTING APPARATUS; A. Albrecht, Lubeck, Germany. App. filed July 30, 1912. Electric current is passed through the pickling salt.

1,055,512. MOUNTING FOR PRINTING ROLLS ON ELECTRO-DEPOSITING TANKS; H. R. Boissier, Great Neck, N. Y. App. filed Oct. 28, 1912. Bearings and electric connection.

1,055,530. DISPATCHER'S TRAIN-CONTROLLING DEVICE; J. Henri, Salida, Col. App. filed June 25, 1909. Electromagnetically controlled semaphore.

1,055,555. TELEPHONE ATTACHMENT; C. R. Phillips, Richmond, Va. App. filed Sept. 23, 1912. Disinfecting mouthpiece.

1,055,560. PRIMARY BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed April 23, 1912. Loose copper-oxide scale electrode and zinc electrode.

1,055,561. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed April 23, 1912. Wire-wound copper-oxide electrode.

1,055,562. PRIMARY BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed May 3, 1912. Zinc electrode at the top and copper oxide at the bottom.

1,055,563. PRIMARY BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed May 3, 1912. Copper-oxide case at the top and zinc at the bottom.

1,055,570. ALTERNATING-CURRENT ELECTRO-MECHANICAL CONTROLLER; A. Sundh, Yonkers, N. Y. App. filed May 7, 1908. Starting, stopping, reversing and accelerating elevator motors.

1,055,578. CIRCUIT-CLOSER FOR INCANDESCENT-ELECTRIC-LAMP SOCKETS; R. H. Vickers, Fayetteville, Ark. App. filed May 27, 1912. Laterally reciprocable plunger.

1,055,591. ELECTRIC FLATIRON; E. F. Stegeman, Hollinsville, Col. App. filed Sept. 10, 1912. Heated supporting rolls.

1,055,598. DRIVING AXLE; D. Balachowsky and P. Caire, Neuilly-sur-Seine, France. App. filed July 12, 1909. Gearless motor mounting.

1,055,642. ELECTRIC DISTRIBUTION SYSTEM; E. N. Lake, Winthrop, Mass. App. filed Aug. 31, 1912. High-tension bus compartments.

1,055,652. ELECTROLYTIC PROCESS; C. J. Reed, Philadelphia, Pa. App. filed May 10, 1911. Receiving iron from a sulphate solution.

1,055,653. ELECTROLYTIC PROCESS; C. J. Reed, Philadelphia, Pa. App. filed May 10, 1911. Spongy lead anode for receiving cobalt from sulphates.

1,055,691. ELECTRIC LINE STRUCTURE; C. Aalborg, Wilkinsburg, Pa. App. filed April 21, 1910. Catenary-system flexible support.

1,055,762. STOPPING DEVICE FOR TRAINS; J. M. Kramlich, Philadelphia, Pa. App. filed Oct. 29, 1910. Throttle and train pipe controlled by the signal system.

1,055,776. SELF-WINDING ELECTRIC CLOCK; W. K. Menns, Chelsea, Mass. App. filed June 27, 1912. Electromagnetically wound.

1,055,782. OVERHEAD-LINE STRUCTURE FOR ELECTRIC RAILWAYS; W. S. Murray, New Haven, Conn. App. filed June 9, 1910. Hanger for curved double-trolley conductors.

1,055,793. CREASING IRON; H. W. Pogue, Decatur, Ill. App. filed March 21, 1912. A heating member and a co-operating shoe.

1,055,802. MAGNETIC SWITCHING DEVICE; C. J. Rowe, California, Pa. App. filed May 4, 1912. For mine locomotives.

1,055,815. THERMOSTATIC ALARM; I. S. Shultz, Easton, Pa. App. filed Jan. 18, 1911. For incubators; damper rod works between two diverging adjustable contact arms.

1,055,850. HIGH-TENSION BLOW-OUT; T. Von Sweigbergk, Southport, England. App. filed Nov. 9, 1909. Energy of magnetizing coil is increased as the arc formed by separation of the contacts lengthens.

1,055,863. TELEPHONE SIGNALING DEVICE; W. G. Blauvelt, New York, N. Y. App. filed May 4, 1911. Ringing current is applied to the line before the interrupter comes into operation.

1,055,870. TELEPHONY AND TELEGRAPHY; S. G. Brown, London, England. App. filed Dec. 12, 1910. Microphonic resistance varying device.

1,055,873. DYNAMO-ELECTRIC MACHINE; J. L. Burnham, Schenectady, N. Y. App. filed Oct. 26, 1910. Effective magnetization of anti-sparking windings varied in accordance with differences of voltage from heel to toe of the brushes.

1,055,877. FUSE CUT-OUT; E. R. Carichoff, Schenectady, N. Y. App. filed Oct. 12, 1911. Fuse of reduced current-carrying capacity at a plurality of points and ruptured portion between such points is ejected by blow-out coils.

1,055,881. PROTECTIVE DEVICE; E. E. F. Creighton, Schenectady, N. Y. App. filed July 15, 1910. Lightning arrester employing electrolytic condenser.

1,055,882. ELECTRIC HEATER; A. S. Cubitt, Fittsfield, Mass. App. filed Jan. 19, 1911. Thermostatic switch opens heater circuit before all the water has been evaporated.

1,055,907. STARTING DEVICE FOR ALTERNATING-CURRENT MOTORS; L. A. Hankins, Schenectady, N. Y. App. filed Sept. 24, 1907. For starting single-phase induction motors; circuit-changing switch cannot be moved to running position until motor has been brought up to running speed.

1,055,931. SPEED-LIMITING DEVICE; L. C. Marburg, Norwood, Ohio. App. filed March 9, 1905. For rotary converters; speed governed by change in frequency of alternations in the source.

1,055,963. CURRENT-COLLECTING DEVICE FOR DYNAMO-ELECTRIC MACHINES; J. G. Zimmerman, Milwaukee, Wis. App. filed May 17, 1912. Dust and spark-producing particles sucked from face of commutator through passageway in the brush.

1,055,985. CONTROLLING FROM A DISTANT POINT THE OPERATION OF A MECHANISM OR INSTRUMENT; C. Berger, Budapest, Austria-Hungary. App. filed Aug. 26, 1909. Sound waves effect operation of electrical devices at a distant point.

1,055,988. TELEPHONY; E. R. Corwin, Chicago, Ill. App. filed June 15, 1909. A common battery energizes the receivers at substations when the lines are united in conversation.

1,055,989. TELEPHONY; E. R. Corwin, Chicago, Ill. App. filed June 15, 1909. Specially compact receiver construction.